Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 7, 1905. No. 15.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....1139 Monadnock Block
PHILADELPHIA OFFICE.....929 Chestnut Street
CLEVELAND OFFICE.....402 Cuyahoga Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
Great Britain and Ireland.....25 shillings
Germany.....25 marks
France.....31 francs
Single copies.....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen moths from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **14,500** *copies are printed. Total circulation for 1905 to date,* **553,500.**

NEW YORK, SATURDAY, OCTOBER 7, 1905.

CONTENTS.

Editorial 599
Completion of Hudson River Tunnels of the New York and New Jersey R. R. Company 602
The Indiana Municipal Code 602
Large Independent Telephone Plants 602
The Struggle for Independent Telephony in New York 603
Metering the Flow of Water in Rivers 603
The American Street and Interurban Railway Association 603
Instruction of Station Employees 605
Central Station and Refrigeration 606
Current News and Notes 606
Electrical Engineers of the Times.—XXX. Prof. Harold B. Smith 608
Electric Operations about Massena 609
Armature Reaction in Rotary Converters. By C. J. Fechheimer and H. A. Berthold 611
Dynamo Iron Loss Increment on Full Load. By A. Press 612
Demonstration Apparatus for Wireless Telegraphy. By A. Frederick Collins 613
Relation of Pull to Diameter of Solenoids. By Charles R. Underhill 615
Electric Railway Equipment 617
New Telephone Patents 618
LETTER TO THE EDITORS:
Pressure Due to Radiation.—Aerial Navigation. By B. Potamian 619
Digest of Current Electrical Literature 619
Absorption of Light by Dust. By Van Rensselaer Lansingh 623
"National" Induction Motors 623
Galvanized Chain for Arc Lamps 624
"American" Arc Lamp 624
Power Development in Wisconsin 624
Thomson High Torque Induction Test Watt-Hour Meter 625
Extension of Acheson Graphite Works 626
Ball Side-Crank Automatic Engines 626
The Advantages of Mechanical Draft 628
Industrial and Commercial News 629
General News of the Week 632

MORE ATLANTIC CABLES.

The Commercial Cable interests are completing this week their fifth cable across the Atlantic, and are pushing onward with work on the Pacific. A fair inference from this would be that not a great deal of Mackay capital has been invested in wireless systems, and that the owners of these and other cables have serene confidence in the permanent value of their investment. In some places there are wireless systems working to-day that would appear to have usurped the functions hitherto attributed to the cable; but when long distances, such as those of the Atlantic are considered, the cable still holds its own, and these newer investments would imply that it is expected to hold its own indefinitely.

We do not say that it is "up to" the owners of the wireless systems to explain this state of affairs. Many reasons can be imagined for delay in establishing steady continuous wireless service across wide reaches of ocean. But the general public will wonder why such brilliant promise has so long an intervening period of negation; and the technical public can only wait in patience without being able to offer or receive much information on the subject. As for shorter distances than the width of the Atlantic there is much encouragement. For example, to take one authentic record, the Signal Corps system up in Alaska has been in operation thirteen months, without a single break or interruption of any kind, and without an error having been checked against the St. Michael's and Fort Davis stations, 123 miles apart, although about a million words have been transmitted, many of them in cipher. If wireless telegraphy must "walk" before it can "run," it seems certainly to have passed through its first stage.

CENTRAL STATION CURRENT FOR REFRIGERATION.

On several occasions we have pointed out the possibilities of power load from refrigerating plants of small capacity, which class of service furnishes an almost ideal means of smoothing out the load curve. Formerly the absence of refrigerating apparatus of proper kind and capacity projected into the future the realization of the obvious advantages, but it seems that the stage has now been reached which makes the subject one that no central station can afford to overlook. Refrigerating apparatus is now offered which has been developed especially for operation from central stations, which is automatic in regulation and which does not require expert attendance. Elsewhere we print an abstract of a paper read at the recent meeting of the Edison Illuminating Association, which gives the result of experience in Philadelphia with this kind of service. This experience has extended over a period of more than a year and covers a great variety of applications, and in every instance the results have been satisfactory, both to the central station and to the user. While the convenience of this kind of refrigeration in itself would in very many cases more than make up for a considerable excess in cost over icing, figures given in the paper show that the new method is decidedly the more economical, the saving in some cases being astonishing. For example, in the case of a drug store doing a large soda-fountain business, total cost chargeable to icing of $1,538.46 was reduced by mechanical refrigeration to $953, this sum including interest on investment and an allowance of 10 per cent for depreciation. With economy thus also in its favor, the prospect of a rapid development of this method of local refrigeration from electrically-driven apparatus appears to be excellent. As to the field offered, it is pointed out that in Philadelphia alone there are no less than 10,000 retail dealers

whose business necessitates artificial refrigeration; and as the system is also adapted for household purposes the prospect opened up to central stations by this new development is most engaging.

ARMATURE REACTION IN ROTARY COVERTERS.

An investigation of the magnetomotive forces of the currents in the armature of a polyphase alternator reveals the fact that if the reluctance were uniform around the air gaps there would be produced a revolving field similar to that of a polyphase induction motor. This field rotates synchronously in a direction opposed to the motion of the armature, and hence it occupies a relative constant direction in space. The magnetism fluctuates in value with a frequency equal to the product of the circuit frequency and the number of collector rings, and the resultant flux oscillates slightly around a certain mean position in space. In a commercial alternator the air gap is not uniform around the circumference of the armature, but the conclusions with reference to the backward rotation of the flux on the armature core and as to the fluctuations in its value and the vibrations in its position in space are directly applicable to a commercial machine.

It can be shown that the actual mean mechanical position of the armature flux with reference to the field poles depends directly upon the power factor of the delivered current. When the power factor is unity, the flux due to the armature current occupies a mean position midway between the field poles, while, when the power factor is zero, the flux is in a position directly to assist the field magnetism if the current is leading, or directly to oppose the field if the current is lagging. As is well known, the above remarks are equally true when applied to a synchronous motor. In the latter case, however, a leading current (so-called) tends to decrease the field magnetism, while a lagging current produces the opposite effect. In a synchronous motor the power factor of the current is determined by the field excitation, so that the mean position of the flux due to the armature current can be varied within wide limits by alternating the strength of the exciting current. It is interesting to observe in this connection that, neglecting minor modifying influences, the amount of distortion of the flux from the field poles is in no wise altered by changing both the value and position of the armature flux due to a variation in the exciting current. This fact is indirectly implied in the discussion given by C. J. Fechheimer and H. A. Berthold on page 611 when dealing with the armature reaction in rotary converters.

As these writers show, the alternating current can be resolved into two components, one in phase with the electromotive force, due to the load on the machine, and the other in quadrature with the electromotive force, due to the excess or deficiency of the exciting current. In a rotary converted the former of these components is more or less fully counterbalanced in magnetomotive force by the direct-current on the delivery side of the machine, so that the distortion due thereto is represented by the amount caused by the current to supply the losses of the machine. The latter component, which is in a mechanical position directly to assist or oppose the field magnetism, can have no effect in skewing the flux from the poles. Since the magnetomotive force of the quadrature component of the current is always in a direction to oppose any change in the field magnetism from its normal value, it would seem that with an armature having negligible local impedance the total flux in line with the field poles is not changed by altering the exciting current. It is evident that this statement applies equally well to synchronous motors as to rotary converters. As the writers of the article referred to have shown theoretically and verified experimentally, however, the change in the power factor of the supply current results in a variation in the distribution of the flux across the circumferential area of the pole faces.

THE ALTERNATING-CURRENT RAILWAY SITUATION.

Mr. Scott's convention paper brings the alternating-current railway question vigorously to the front. For many months it has been in committee, as it were, with frequent and somewhat fervid argument going on, and much waiting for evidence. It must now be regarded as fairly before the house with a favorable, if somewhat guarded, report behind it. We have published from time to time various reports from foreign alternating roads. The evidence is upon the whole favorable, in fact, most encouraging; and with the announcement that the N. Y., N. H. & H. R. R. stands committed to the new system, we must regard the alternating-current railway as fairly out for business on a large scale. Until recently it has often looked as though its supporters were somewhat half-hearted, recommending it in the abstract and side-stepping the issue in the concrete, but to-day the alternating-current motor must be reckoned with as a serious competitor in any large railway proposition. Undoubtedly there will be many improvements made and the system as it exists to-day cannot be considered a finality, but it has certainly won the right to most respectful consideration.

We have consistently held for a long time past that only by using high voltage on the working conductors can heavy electrical railway operation over considerable distances be successfully accomplished. We have been called down in the name of uniformity, standardization, and the third rail "system," whatever that may mean, and have still cheerfully harped away on the high-voltage string. There is no dodging the issue, and the alternating motor in whatever form meets it squarely. The experiments of the past few years have gradually shown that alternating motors of several types can be made to meet the severe requirements of electric traction, and their record up to the present has been at least encouraging. Engineers have been divided, as in the good old times, into opposing camps on the frontier, and more than a little of the old-time acrimony has appeared in their discussions. Some have sturdily and some weakly supported the newcomer, and many have damned it with faint praise. In the meantime it has worked out of the realm of argument into that of reality, and it must be admitted from now on as a genuine competitor in electric railway work. What the future of the alternating-current traction motor, in its present form, may be we hesitate to predict, but it can no longer be put aside with a superior smile, as of possible practical usefulness in some other case than the present. It is interesting to note, too, that the bow trolley, which everyone who has followed foreign practice has known as particularly well adapted to collecting heavy currents at high speed, has at last won a right to a hearing in this country. In fact, a modification of it has already been in successful use on the Coast, which has served as a trial horse for so many improvements.

Another suggestion in Mr. Scott's paper is his discussion of variable-speed control, pointing out that the ordinary direct-current motor is not well adapted to operation at a wide range of speeds, and that in fact the controller for an alternating system is the simpler and more effective. It must not be supposed that at this early stage of the fight the direct-current motor is "down and out" by any means, but it is long past the point where it can conduct its battle on paper. To take a conservative view of the case, the time has now arrived in which a judicious engineer in planning any considerable electric road must consider the alternating system strictly upon its merits, not as a theoretical improvement, but as a practical

reality. Its general advantages are manifest. It is a clear gain to do away with the costly and somewhat inefficient rotary converter sub-station, and the tons of feeder copper required to distribute 500-volt current. It is also a gain to get away from the serious difficulties entailed by the distribution of enormous currents on the working conductors, and to come back to a simple overhead construction. That these gains will be made without some sacrifice is hardly in the nature of things to be expected, and the next step is to determine how great is the price which must be paid for the gain and in what currency it must be settled. This is the problem for the traction engineer to-day. The result will determine the status of alternating-current traction. Something will depend on the facility with which a single equipment can be made to play the double rôle required in passing from alternating-current to direct-current conductors. Mr. Scott does not seem to be unduly optimistic upon this particular point. Even so, there are numerous cases in which this condition does not seriously enter the problem, and there will be the first battleground of the respective systems. The vital point is that the plain issue can no longer be dodged and that the fight will be to a finish.

International Electrical Engineering Standardization.

One of the greatest services which the American Institute of Electrical Engineers has done for the electrical engineering industry has been the formulation and adoption of a set of rules for the standardization of certain details of electrical machinery and apparatus. These rules have come into almost universal use in the United States, to the great benefit of all parties concerned. The manifest design of a set of standardization rules is to simplify the classification and testing of machinery, by the recommendation of a rational system of sizes, and other characteristic properties for the various machines ordinarily used. The general adoption of standard definitions, ratings and methods of testing is of enormous advantage to the electrical engineering public. The opportunity for misunderstanding in contracts and specifications is minimized by conformity to standard rules. Moreover, if the methods of rating and testing are clearly defined, the manufacturers are better able to judge in advance of the precise behavior of apparatus under construction. They have less need for a margin of extra security owing to uncertainty of testing methods, and they are thus enabled to reduce the cost of the machines, the purchaser in many cases benefiting from such reduction. Standardization rules in general use in electrical industry have saved, and are saving an enormous amount of waste material, time, labor, uncertainty, vexation and litigation. Other countries also have undertaken the formulation and adoption of electrical standardization rules. England, France, Belgium, Germany, Italy and Switzerland in particular have taken action in this direction. It would seem probable that before long every civilized country will adopt such rules. It is manifest that the advantages which are secured in any one country, such as the United States, by these rules, would be sought for in each and every other country by similar means.

It is, of course, inevitable that the standardization rules independently adopted in different countries should differ. The manufacturing and economic conditions differ materially in different countries, and these alone would tend to determine variations in standardization rules. It is, therefore, very doubtful whether uniform rules should or could be adopted internationally in such matters as relate merely to conditions of manufacture. International uniformity of standardization rules is, however, most to be desired in matters of definition, rating and testing. There seems to be no reason why a dynamo which is rated as of one hundred kilowatts power in one country should become rated as of eighty kilowatts under the rules of another country, or of one hundred and ten kilowatts under the rules of a third country. The conditions which determine the rating are heating, regulation, sparking and mechanical strength. These conditions are physical and mechanical. They are not local exigencies of manufacture. It is true that a motor which is operated in the tropics may have a lesser safe output than a similar motor operated in the arctic zone; but such modification of rating as may be applicable to local temperature conditions should also be determined and adopted internationally. It is generally admitted that all electrical machinery should have the same classification, rating, and methods of determining the rating, all over the world. These matters should not be questions of latitude and longitude. Nothing is needed to establish international standardization on these points except international discussion and compromise.

The international electrical Congress of St. Louis last year took this matter under consideration and adopted a resolution in favor of the plan. It was proposed that the various national societies of electrical engineers should communicate with one another with a view to taking steps towards the accomplishment of this desired result. Two consequences should follow upon the successful adoption of even the most elementary foundations of electrical engineering standardization. The first would be the advantages to international commerce in electrical machinery, by the elimination of uncertainty, misunderstanding and cause of dispute. This would be a universal commercial advantage. Any electric machine which had its rating correctly established in one country would thereby have its rating at the same time established for all other countries. The second advantage that might be expected to follow in the wake of international standardization would be less demonstrable from a utilitarian or commercial standpoint but might nevertheless be of considerable indirect international value to electrical workers. It should result from the closer association of the national electrical engineering bodies that would inevitably be brought about by their co-operation upon an international set of electrical standardization rules. This co-operation should increase the cordiality, respect and mutual good will of electrical engineers in all parts of the world and pave the way for their harmonious international co-operation in other directions. It is high time that steps were taken to carry out the suggestions of the International Electrical Congress of St. Louis in regard to international standardization. It is to be hoped that the American Institute of Electrical Engineers may take this matter up at an early date.

There can be no doubt that if the American society were to communicate with its sister societies abroad, interest in this subject would be cordially reciprocated. The first step taken might be to determine by correspondence the precise status of national electrical standardization in each country. Then discussion might be taken up by correspondence between committees of these national societies in regard to the possible unification of the simplest physical and mechanical definitions of rating. After the practicable matter has been sifted from the impracticable in this way, a meeting of delegates from the societies might be called at some convenient time and locality in Europe to discuss the matter and arrive at a tentative international understanding, subject to the ratification of the governing bodies of the societies represented. In such a manner the first steps towards international electrical standardization might be completed in a single year at a very small cost and with great mutual advantage.

Completion of Hudson River Tunnels of the New York & New Jersey R. R. Company.

An important event in the history of New York City's traction facilities was witnessed Friday, September 29, in the completion of the tunnel system of the New York & New Jersey Railroad Company under the Hudson River between Hoboken and New York. The uncompleted south tube of this tunnel system, which has been under construction from the Jersey side of the river, a few days ago reached the wall of the working shaft on the New York side, at Morton Street and the river front, and this wall was forced through Friday afternoon in the presence of the officials and directors of the above company and also of the Hudson Companies, the construction company directly in charge of the prosecution of the work. The event was attended with considerable ceremony, marking the entire and successful completion of the under-river portions of this tunnel project. The officials, together with a party of invited guests, entered the south tube through the entrance shaft near Fifteenth Street, Jersey City, from which all of the work of construction has been carried on, and rode through to the barrier wall at the New York end, where Mr. W. G. Oakman, president of the Hudson Companies, operated the hydraulic jacks which forced the final opening through the wall and permitted the party to make the first complete trip through this tube.

Among those present in the party representing the New York & New Jersey Railroad Co. were W. G. MacAdoo, president; E. F. C. Young, director; C. W. King, secretary, and A. B. Conger, treasurer. The Hudson Companies, the construction company, was represented by W. G. Oakman, president; Pliny Fisk, director; W. N. Barnum, director; W. C. Kinney, treasurer; William H. Barnum, assistant treasurer; Charles M. Jacobs, chief engineer; J. V. Davies, deputy chief engineer; G. D. Snyder, principal assistant engineer; H. M. Sperry, consulting signal engineer; R. S. Courtney, works manager; F. K. Hilt, division engineer, and Dr. A. J. Loomis, medical director at the tunnel. Mr. L. B. Stillwell, consulting electrical engineer, was represented by Mr. H. Hazleton, his assistant.

The completion of these tunnels is of interest in that it marks the culmination of an enterprise that was projected over thirty years ago and, although regarded at that time as an impossible undertaking, was carried well along toward completion before being compelled by engineering difficulties and lack of financial support to be abandoned. At the time work was stopped in 1881, the north tube was nearly half completed and work had been begun on the south tube. Work was again taken up by the present company in 1902, after a delay of eleven years, and has been pushed to completion in record time. The north tube was completed in March, 1904, and the work of lining with concrete and of installing the cable ducts at the sides is well advanced. Now that the south tube is completed and the air pressure used with the shield method of construction is removed, similar work will be vigorously prosecuted there also. Work is progressing so rapidly upon the approaches that it is confidently expected that cars will be running upon the system early in 1907.

The length of the tunnels between the shafts at Fifteenth Street, Jersey City, and Morton Street, New York, is 5,780 ft., the interior of each of the tubes being 15 ft. 3 in. The tubes are laid nearly parallel, separating only about 50 ft. toward the middle of the river, and have no cross communication at any point between the shore shafts. The greatest depth below mean tide is near the middle of the river, where the tubes are 15 ft. below the bed of the river, the depth of water at that point being 65 ft. Each tube will provide for a single track, the north tube carrying west-bound traffic and the south tube the east-bound.

The plans for the terminals upon the New Jersey side of the river have not been definitely determined, but it is probable that connection will be made with the principal ferry terminals, so that incoming passengers may have the advantages of direct connections with the principal points of the city without the dalays and inconveniences of the present ferry accommodations.

The New York approaches to the tunnels have been carried to some distance eastward from the Morton Street shaft. Construction upon these is being carried out upon the shield and hydraulic jack method, similar to that for the tubes beneath the river, the shields for the approaches having now reached Christopher Street. The present plans for the New York terminal call for a line running up Fourth Avenue as far as Thirty-second Street, with stations at Fourteenth, Eighteenth, Twenty-third and Twenty-eighth streets, and a branch through Ninth Street to make connection with the Interborough subway at Astor Place.

The Indiana Municipal Code.

Mr. H. O. Stechhan, in the October-December *Forum* has an interesting article with regard to the new Indiana municipal code. He says:

"Uniform government in all the cities and towns of Indiana is the end which the new municipal code enacted by the General Assembly this year seeks to achieve. It marks a distinct step forward in city government, and is intended to work a number of important reforms in the general conduct of municipal affairs, placing them on more of a business basis.

"The code repeals all so-called individual city charters and separate incorporation acts, with special grants, under which the different municipalities of Indiana have been organized heretofore, and extends the same broad principles of local self-government to all. Owing to the varied systems of management that these cities and towns have had in the past, the experience of one contributed but little to the well-being of its neighbor, each being compelled to learn the same lesson for itself. This fact inspired the code, and it was drafted for the express purpose of meeting the wants of all similar communities within the confines of the State. Indiana's municipal code is constructed after the pattern of the city charter that prescribed the government of Indianapolis, the State's capital city, from early in 1891 until the middle of April, 1905, when the new law went into effect. Thoroughly tried and tested during the fourteen years that it was in force, the Indianapolis charter came to be regarded as one of the best to be found in our country.

"In some quarters, what is known as the 'city-made charter' is the most approved form of municipal law at the present time. This means a body of law that has been made and adopted by the people themselves for whom it is intended, after which it has been ratified by the legislature of the State, as distinguished from a code of laws originating in the General Assembly, as most city charters do. Constitutional provisions in Missouri and California authorize 'city-made charters' for cities having more than 100,000 population. Kansas City, Mo., is the latest municipality to make its own government. Fourteen years ago Indianapolis, through a committee of public-spirited citizens, built for local needs the body of law which the Indiana legislature approved at the time; and so satisfactory has been its operation in the interim that this year's assembly saw fit to apply the provision of this organic law, 'city-made' according to the latest meaning of the term, to all the cities of the State. For the larger cities the same machinery of government employed in Indianapolis for fourteen years has been adopted, though minor modifications have been made to adjust it to the varying needs of the smaller ones. Where a sort of governmental chaos has existed in the local affairs of municipalities within the State, this act is expected to bring about systematic regularity."

Large Independent Telephone Plants.

Following is a list of the approximate number of independent telephones in use in some of the larger cities of the country:

Philadelphia	17,000
Los Angeles	16,000
Pittsburg	15,000
Cleveland	15,000
Minneapolis and St. Paul	14,000
St. Louis	13,000
Kansas City	11,000
Chicago (business telephones only)	10,000
Indianapolis	9,000
Louisville	8,000
Buffalo	7,600
Rochester	7,500
Seattle	6,500
Grand Rapids	6,200
Columbus	6,000

In the State of Pennsylvania there are more than 30 cities having over 10,000 population each, in which there is an independent telephone company.

By some authorities it is figured that there is $250,000,000 capital invested in the more than 5,000 independent companies in the country at the present time.

The Struggle for Independent Telephony in New York.

A large number of applications are on file in the New York Board of Estimate and Apportionment for telephone franchises in the greater city and environs. Each of the applicant companies agrees to give the city the use of six hundred telephones.

The applications now on file with the Bureau of Franchises, pending final disposition by the board and the aldermen, are as follows:

Atlantic Telephone Company: Joshua D. Powers, president; home office, Louisville, Ky. Petition received June 2, 1905.

The Atlantic company asks for a franchise in New York City only.

The Atlantic company proposes to charge five cents a call and $66 a year for unlimited service for private residence telephones and $108 for unlimited service in business places. The franchise is for twenty-five years and the rental to be paid the city is a sum equal to 1 per cent of its gross earnings for the first two years, 2 per cent for the next three years and 4 per cent for the remaining twenty years, the city to have the free use of five hundred instruments.

Star Telephone Company; Richard J. White, president; home office, New York City; capital, $1,000,000. Petition received June 30.

The Star company's application covers New York State and the Middle and New England States.

The Star company's rates are five cents a call for messages and slightly lower yearly rates than those named in the Atlantic company's application.

Commonwealth Telephone Company; Edwin M. Brooks, president. Petition received July 14.

The Commonwealth company states that it expects to operate in New York, New Jersey, Pennsylvania, Delaware and Maryland.

The Commonwealth proposes to charge five cents a call, $90 a year for business telephones in Manhattan, $75 in Brooklyn and The Bronx and $60 in Queens and Richmond.

Metering the Flow of Water in Rivers.

In a paper read before the Boston Society of Civil Engineers, Mr. H. K. Barrows described an electric meter for determining the flow of water in rivers as used by the Hydrographic Branch of the United States Geological Survey. There have been many forms of flow meters used by the Survey in one way or another, but it has been found that the Price electrical meter gives, in general, the best results for river work. This meter is made in two sizes, the smaller size for use at ordinary and low-water stages, and the larger size, which is built stronger, for use when the velocity is high and the number of revolutions of the smaller meter would become too great for counting. The meter is suspended by a double-conductor cable which is heavily insulated. When this cable is new and in good condition it will safely carry a lead weight of 35 or 40 pounds for holding the meter in place.

The meter proper consists of cups of peculiar shape, mounted upon a shaft which revolves with a speed proportioned to the velocity of the water. In the Price meter, the shaft is vertical, and the greater part of the weight of the moving parts comes on the lower bearing which is adjustable by means of screws. The top end of the shaft of the meter is bent slightly so as to give it an excentric motion as the cups revolve, thus making and breaking an electric circuit as each revolution is made.

The primary cell used is small and compact in form, and is the result of a great deal of experimentation. It consists of a hard rubber cell with a cylindrically shaped carbon which is connected with a platinum wire extending through the bottom of the cell. The other pole is of zinc extending through a rubber stopper which closes the cell. This cell fits in a case, and is connected in circuit with a buzzer through the contact device of the flow meter. This form of apparatus gives more or less trouble, owing to the various parts of the buzzer getting out of adjustment, but so far it is the most satisfactory form devised. It has, at least, the advantage of being exceedingly compact in form, and can be placed at the end of the cable near the observer. Experiments have shown that with the smaller Price meter, measurements of velocities less than about 4 ft. per second are not reliable, the chief reason being that the friction of the meter on its bearings grows relatively greater as the velocity decreases. Two important improvements which are now being considered are the use of ball bearings which should make the low velocity readings much more reliable, and the use of some device whereby, when desirable, only every fifth (or tenth) revolution of the meter will be recorded. This latter improvement will enable the small meter to be used for high velocities, and will result in a greater field of usefulness for it.

At the present time there are some 20 metering stations in Maine maintained by the Geological Survey, and covering most of the principal rivers of the state. Throughout the other New England states there are 23 additional stations, distributed as follows: New Hampshire, 13; Massachusetts, 5; Vermont, 3; Rhode Island, 1; Connecticut, 1.

Besides the matter of obtaining estimates of flow of rivers, the Hydrographic Branch is devoting some time to the procuring of river profiles, and such data as will be of value in pointing out to capitalists suitable sites for power development.

The American Steel and Interurban Railway Association.

During the Philadelphia meeting of the American Street Railway Association and affiliated societies last week, the plans for reorganization were carried through, a new constitution being adopted and the name of the combined societies being selected as "The American Street and Interurban Railway Association." The following officers were elected: President, W. Caryl Ely, Buffalo; first vice-president, John J. Beggs, Milwaukee; second vice-president, Calvin G. Goodrich, Minneapolis; third vice-president, James F. Shaw, Boston. Under the new plan of organization, the members of the executive committee are made up of the presidents of the affiliated organizations. The executive committee is as follows: H. H. Adams, Baltimore, of the Mechanical Association; S. L. Rhoads, Philadelphia, of the Claim Agents' Association; W. B. Brockway, Nashville, of the Accountants' Association.

Four papers were read before the American Street Railway Association. Two of these by Arthur West and J. R. Bibbins, which dealt with gas engines, were printed in abstract in our last issue. The other two papers treated of single-phase and direct-current railway equipments. The paper by Charles F. Scott, on "The Single-Phase Railway System," was abstracted on page 596 of our issue for September 30, while a review of the paper by W. B. Potter on "Electric Railway Equipments," may be found on page 617 of the present issue. A digest of the discussion which followed the reading of these papers is given below.

GAS ENGINES.

In opening the discussions of the papers dealing with gas engines, Mr. C. O. Mailloux stated that he had called attention last year to the fact that evidence at hand went to show that with coal at $2 per ton the steam plant and the gas plant were about equal as to the cost of producing power. Mr. Bibbins, however, showed that the two should be on an equality when the coal costs $1 per ton. He wished to know why such a change had taken place within one year. Mr. Bibbins replied that he was not familiar with the assumptions made the year previous, but the greatest item in determining the price for coal at which the two plants show equality is the load factor. In his own paper he had assumed a load factor corresponding to an average railway plant, which is 66 per cent. If the load factor is that of an electric lighting plant, barely 25 per cent., the results would be quite different.

Mr. Charles Hewitt questioned the accuracy of the figures used by Mr. Bibbins. Whether the comparisons made between the particular gas and steam plants were correct he could not say. But he was sure that steam plant selected was very uneconomical. Anthracite buckwheat coal contains between 11,000 and 12,000 heat units per pound of coal. The figures given indicate that this coal would run from 6.5 pounds to 8 pounds per kw-hour. The poorest plant with which he was personally familiar showed better results than that. He was familiar with plants running non-condensing which showed 4.5 pounds of coal from year's end to year's end. The consumption will run as low with good coal as 4¼ pounds, seldom over 4¾ pounds, and the average for the year will

be 4.4 pounds to 4.5 pounds. Running condensing with the same quality of coal, it is perfectly possible to run at 3.5 pounds of coal. Mr. Bibbins said that figures given referred to a non-condensing plant. He thought it was safe to say that the relative coal consumption between steam and gas plants would be about two to one.

In reply to a question by Mr. Mailloux, Mr. Bibbins said that a smaller plant will cost more per kilowatt than a larger one even though the same number of units were instilled. The small gas engines, however, will show an efficiency quite comparable with a large one, while the relative efficiency of the steam plant will decrease much more rapidly with small units, and this item might readily more than balance the increased capital cost.

Mr. W. E. Winship related the experience with the gas engine plant installed for the Gould Coupler Company, at Depew, N. Y. This plant consists of three Westinghouse vertical gas engines, rated at 235 horse-power each, with the Loomis-Pettibone gas system. The plant cost almost exactly $115 a brake horse-power to install. It was estimated that it would have cost $90 per horse-power for a steam plant, equivalent to the gas plant, excepting as regards coal consumption. In regard to the overload capacity, it was estimated that by installing a storage battery the same overload capacity could be gotten out of the plant. After the batteries are installed the plant will have cost about $130 per brake horse-power, and for the same overload capacity as the steam plant. The coal consumption, based on coal containing 13,400 B. T. U. per pound, has been on a monthly average 2.26 pounds per kw-hour at the switchboard, with a load factor on the plant of roughly 50 per cent for twenty-four hours' operation. On a series of 65 days when the load factor was approximately 65 per cent, the coal consumption went down to 2.02 lbs. as an average. The lowest record for twenty-four hours' period of operation, when the load was especially good, was 1.79 pounds of coal for a kw-hour on the switchboard. That load is very similar to what is used in street railway work. The peaks, when the load is heavy, are fully 60 per cent above the average, and when the peaks are lighter, they are fully 100 per cent above the average load. The conclusions were that with coal at $2.30 per ton, and with the plant operated for about fourteen or sixteen hours a day, the steam plant and the gas plant would have just balanced each other, but that with the twenty-four-hour operation the gas plant is more desirable. In regard to the reliability of the plant, he could state that it has been fully as reliable as any steam engine plant that could have been put in.

Mr. Hewitt remarked that it might be of interest to some of the members to know the latest results in steam turbine plants, which he had received only a few weeks ago from New England. As opposed to the 2.26 pounds of coal, which Mr. Winship gave as the average for thirty days, the results show 2.4 pounds to 2.6 pounds per kw-hour with bituminous coal. The average is 2.5 pounds for turbines as against 2¼ pounds for gas engines. One of these plants has five units of about 1000 kw; the other has two units, and he thought in the latter case there were about 1500 kw using superheated steam.

ELECTRIC RAILWAYS.

The papers of Messrs. Scott and Potter were discussed together.

At the conclusion of the reading of his paper, Mr. Scott remarked that the single-phase system and its apparatus must be developed in the course of a few months or a few years, not only to equal, but to more than equal the result of the development of the direct-current system during the past dozen years. A great deal of that development can be done by the designing engineers in the factory, but, as we all know, the service test is the final test, and a great many of the practical points as to control the interworking of various parts, the best forms of apparatus must come from experience. The experience has been begun, but just as with the direct current after its fifteen years, so the alternating current after as many months has not reached perfection, but the manufacturers have reached that point where they feel that with the knowledge of the apparatus and with the experience which has been secured, it can now be presented to the operating street railway man as a perfectly feasible and practicable system.

W. E. Goldsborough stated that he did not believe that any designer of electrical machinery to-day is satisfied in his own heart with the single-phase commutator motor. He felt confident that in time, through insistent and persistent work on this problem, there will be produced a single-phase motor which will be more nearly analogous to the multiphase motor and which will not have a commutator.

C. O. Mailloux said that while he had much faith in the single-phase system, he did not believe that the direct-current system would be discarded immediately. In many cases of long-distance traction to-day the single-phase system, even in its present state, will be more practicable than the rotary converter sub-station system. It may be alleged as an excuse for this latter system that it was introduced at a time when it would have been impossible to have gone very long distance without it. There are doubtless many cases in the Middle West where the system is eminently practicable, and where it is to-day the very best. These cases are found where the traffic is very frequent and where there is sufficient mean power distribution over the whole line to warrant the use of such stations. He said that his criticisms refer particularly to the cases where the cost of operating sub-stations is so great that the engineers are trying to find employment for the men who run the sub-stations, by making them wind armatures or field coils, so as to justify charging the larger part of their time to the mechanical and repair department. Some of these cases are sad, and would have been prevented by a little discretion or discrimination in the selection of the system. That there are to-day two good single-phase systems, both of them sufficiently good for the great majority of these cases just noted, is significant. The single-phase alternating-current motor will greatly enlarge the field of operation of the companies employing the direct-current motor system, by enabling them to extend their lines in the suburbs. Such companies should run the lines in the city with the direct current as they have been doing. They can, if necessary, buy a few new single-phase equipments for the suburban lines; then run with direct current inside of the city limits, and even for some distance beyond, use the alternating current (single-phase) to operate the longer suburban lines. There will, doubtless, be a very large field for that sort of work, and we are apparently on the point of realizing it practically.

In response to the request of Mr. Scott, G. D. Nicoll, chief engineer of the Indianapolis and Cincinnati Traction Company, related the experiences of his company with the single-phase railway. Operations were begun on the first day of January of this year. On the first day of April the cars ran within four miles of Indianapolis, all of the operation being on alternating current. Difficulty was experienced in getting into the city of Indianapolis on account of two overhead bridges which were so low that the cars could not pass under them. These were raised, and on the 1st of July cars began to run into Indianapolis. The line then was 41 miles in length, 37 of which was on alternating current, and the remaining 4 miles on direct current in the city of Indianapolis. Up to the time of beginning operating into the city, there had been no trouble with the motor insulation. The worst trouble was the question of the transformer ventilation. This was overcome, but on operating the motors in the city of Indianapolis defects developed in the motor windings. These were also overcome, and there has been no further trouble. The company is operating the highest schedule that is maintained in the State of Indiana, collecting the current by means of a bow-trolley. No trouble whatever has been experienced with the bow-trolley. He was not able to give any data as to the car mileage or the life of the shoe of the trolley, which is composed of wood plated with aluminum, but stated that the cost of operation and of renewing the shoe is not more than would be the case with the ordinary trolley. The company has been well pleased with the operation of the equipment. Some minor changes have been made in the apparatus, but on the whole it is very satisfactory.

John J. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, requested some information concerning the advisability of installing single-phase motors upon a certain interurban route. There are now being built three 12-mile extensions, the farthest point of which will be 33 miles from the center of operation. It is the intention to continue these extensions to 75 or 80 miles, possibly 100 miles, in the development of that section of the country. It is a serious question whether to adopt the composite motor; and if it would be equally effective with the direct current as it would be with the alternating current in the more sparsely settled sections of the State, on many of the lines a car operating only once every 2 hours. Representatives sent to investigate the various lines operated with alternating curent have given very conflicting reports concerning them. One of the most recent reports was to the effect that the system was so unsatisfactory that it was to be abandoned. In reply to Mr. Beggs' question, Mr. Potter said that there is no doubt that the alternating-current motors can perform any service now done by direct-current apparatus. The selec-

tion of the type of motor is mainly a financial and not strictly an enginering proposition.

Both of these factors are, however, closely related, and while it is the latter which determines the former, it is the former, giving due consideration to all incident advantages, which should govern. The alternating-current motor when running on direct current will do even more work than it will on alternating current. A good alternating-current motor in a general sense is a most excellent direct-current motor with respect to acceleration and heating. On a road of, say, 50 miles in length, employing few cars, the saving secured by the use of a high-potential trolley would be so much greater than the additional cost of the alternating car equipments that there would be little question but that alternating-current apparatus would be more suitable for such a proposition. On a road of a few miles in length and having a number of cars per mile the relative cost of the alternating car equipment would be a much larger proportion of the total cost, and whatever saving could be made in the trolley conducting system would be relatively small. It is not, however, wholly a question of initial cost, but it may be said in general that where the initial cost for alternating-current and direct-current installations are about equal, the choice should be for direct-current equipment, owing to the lower probable maintenance of the installation as a whole.

In reply to a criticism by Mr. Hall as to the relative acceleration of direct-current and alternating-current motors, Mr. Scott said that the rate of acceleration in the motor depends upon the rate of application of higher voltage to the motor; in other words, upon the rate at which the controller is thrown on. The rate of acceleration on the alternating-current motor in some cases has been slow, because the controller was thrown on slowly. For example, on the Indianapolis road, if the controller handle, which is adapted to both direct and alternating current, should be turned at the same rate, it happens to give a much lower rate of acceleration on alternating current than on direct current. In order to get the same acceleration in the case of alternating current the controller should be moved faster. Some of the earlier motormen, who were accustomed to operate on direct current, operated in the same way with the alternating current, and got a slower acceleration for that reason. When the rate of the movement of the controller was increased the rate of acceleration of the car was increased also.

Instruction of Station Employees.

Mr. W. F. Wells, superintendent of the Brooklyn Edison Company, at the Lake Champlain convention of the Association of Edison Illuminating Companies, read a paper on "Instruction of Men Operating Interconnected High and Low-Tension Systems, with Reference to Safety of Employees, Reliability of Service, and Resumption of Same after Partial or Total Interruption." The paper deals with the experiences of the New York Edison Company, and presents in complete form the instructions which are given to the employees at the various stations, feeder sections and sub-stations.

As the Edison system increased in size and complexity, and the service from each station became more and more dependent upon what occurred elsewhere, it was found necessary to broaden the organization and to raise the intellectual standard for the station operating men. For operating the steam plant of the generating station, the high-speed stationary engineers and assistants were replaced by men trained and disciplined on the Atlantic steamships. These men quickly learned that a signal from the electrical switchboard to start or stop an engine was as imperative as an order from the pilot house, and they soon realized that when required, engines must be kept running at all hazards. They were accustomed to the operation of engines with heavy parts, were self-dependent and have been found capable of acting promptly and with good judgment when the situation demanded it.

For the electrical operators the proposition was entirely different; the equipment being installed was of a new type, the details of which had not been fully developed, and consequently there were no men trained in its manipulation. Nor had any instruction books been printed, describing the construction of the apparatus, or its operation in connection with an electricity supply system, in a manner that would be comprehended by the men best fitted to operate it. Experience has shown that the best men for this service were those who had some mechanical training and who possessed a technical knowledge of electrical apparatus about equivalent to the steam knowledge required for licensed engineers. These men submit to the discipline and monotony of the position, by education and training become quickly acquainted with all the details of the station equipment and outside system, and in case of trouble quickly ascertain the cause and then act coolly and promptly. Their interest in the work is increased and the men induced to study and improve their condition by promoting from time to time those capable of filling positions of increased responsibility, this being partially determined by periodical examination. As a rule graduates from the technical schools have been found unsatisfactory for this class of work. As soon as they had mastered the details of the position the monotony of it would become irksome and they would secure employment elsewhere.

In the instruction of new men they are first given to understand that they are assuming certain responsibilities, that they must comply with all the rules and be conversant with all instructions issued for their guidance, and further, that if rules are not observed, action will be taken. It is only by maintaining strict discipline that best results can be obtained.

The method of instructing electrical operators varies with their positions, which, in the New York Edison Company are graded as system operators, foremen, regulators, and various assistants.

With the system operator, experience is the teacher, and the text-books are the load curves and reports from the entire system. These are made the subject of exhaustive study and from them are deduced plans of action for the future. In order to be prepared to meet exceptional emergencies, which it is hoped may never occur, conditions are assumed, and operators in all stations trained and drilled in executing a carefully prearranged plan. As an instance, twice each month the steam engineers at the generating station and the foremen and electrical operators in all stations are drilled under the direction of the system operator in starting engines and rotaries from rest, as would have to be done in case of total shut down on the system. This drill, which consists in starting one and additional rotaries in the various sub-stations, one and additional engines in the generating station, and synchronizing both rotaries and engines at low voltage and frequency, has brought out many details, such as methods of starting engines, low voltage synchronizing devices, field excitation most suitable on generators and rotaries, the use of batteries, etc. By such means the men are trained to think and at the same time become familiar with what may be expected of them in case of serious disturbance.

A man becomes a foreman only after he is thoroughly acquainted with all the known details of the construction, operation, and repair of the apparatus. His instruction, therefore, is on the broad lines of discipline, methods of handling and educating men, thoroughness in investigation of trouble with apparatus or employees, and clearness, accuracy, and conciseness in making reports. He must maintain a certain dignity with the men, and guard against familiarity or favoritism. He should instruct the men to perform all operations and never personally operate a switch unless absolutely necessary.

For the regulators, assistant regulators, switchboardmen, brushmen, etc., it is customary to employ men for the lower grades and promote them to better positions when warranted. Each man is thoroughly trained and drilled by the foreman in the operation of the apparatus under his care and becomes perfectly familiar with all its connections before he is called upon to work on other apparatus.

As the apparatus in the stations increased and the connections became more complicated, various methods were developed in the different stations for accomplishing the same purpose. In order to avoid confusion and establish uniformity it was found desirable to issue rules and instructions for the electrical operators. In some cases it was possible to make these rules inflexible, but in other cases broad and general instructions were issued as to the methods to pursue under given circumstances, and the man depended on to use his judgment. The rules for all employees handling high-tension cables and apparatus, and detailed instruction for operating men as to the best methods to be followed in both generating and sub-stations in case of serious disturbance to the system have been issued in booklet form to the men and their receipts taken so that no excuse can be given for ignorance. The rules and instructions for the operating men in the generating station have been collected in the form of a rule book very similar to that used on the large railway systems of the country. These are issued in a loose-leaf

book, and when existing rules cannot be enforced by reason of later experience, or further developments in the apparatus, necessary changes or modifications are made, as a single obsolete or illogical rule tends to nullify the importance of all the others. In general this book defines the position, responsibility, and duties of each class of electrical operators; it contains concise, yet complete detailed instructions for the men in the different positions so that the substitutes are fully prepared to take the place of absentees; it contains general and detailed instructions for the operation of all apparatus and for the safety of all employees working around high-tension apparatus.

It is impossible with a rule book, by education, or by any other means, to make a good man out of poor material, but by placing rules and instructions of this sort in the hands of intelligent men to be used as a guide by requiring of them complete observance of the rules, and by questioning them as to their understanding of the various instructions an organization may be developed which will successfully cope with any operating problem.

Central Station and Refrigeration.

Among the papers read at the recent meeting at Lake Champlain of the Association of Edison Illuminating Company was one by Mr. G. W. Goddard, entitled "Relation of the Central Station to the Motor-Driven Refrigerating Machine." Mr. Goddard pointed out the growing use of refrigeration in towns and cities, and as electric power has particular advantage in driving refrigerating machinery, the situation is one that should not be overlooked by central station men. He advised the study by these of the processes of refrigeration and the looking up of electric power business in this field. Twenty years ago artificial refrigeration was in its infancy, and yet to-day it is making the entire ice output of the Southern states, supplying the ice to refrigerating cars from the west and south, and preserving and regulating the delivery of meats, fruits and other commodities. Through refrigeration millions of dollars worth of perishable goods are stored for any desired length of time for supply to the smaller dealers; and it is this latter class who can derive a particular benefit by use of the smaller refrigerating machines now made and arranged to be driven by the electric motor.

About 18 months ago the Philadelphia Electric Company added a refrigeration department to its business, putting into effect at the start a system of publicity through illustrated pamphlets and following up by a personal call. As a result of this work, plants have been installed in dairies, dry goods stores, grocery stores, residences, restaurants, saloons, office buildings, apartment houses, etc. The paper gives descriptions in detail of several typical plants installed for different refrigerating purposes, together with data of tests and cost of refrigeration.

In the case of a dairy the cost of ice refrigeration was $779.25, and of an electrically-driven refrigerating plant $735.75, this latter figure including cost of electric power, water for condensing and fixed charges. The electric system, in addition, demonstrated its great advantage in regulating temperature at will under sanitary conditions and regulating refrigeration to the amount of material to be cooled. In a grocery store the cost of ice refrigeration had been $92.20, and of mechanical refrigeration $42.21, giving a saving of $49.99 in favor of the latter. In addition to interest on investment, all of the costs given in the paper include an allowance of 10 per cent for depreciation and repairs. The greatest difference was found in the case of a drug store, where the cost of ice refrigeration was $1,538.46 and the cost of mechanical refrigeration $953, making a saving of $585.46. In the case of a restaurant the corresponding figures were $640.50 and $414.86, the saving thus being $225.64. Data are also given of a plant in a butcher shop and in a saloon, there being a saving also in both of these cases. Data are also given of the results of operation of an installation in a residence. In this case the machine was under the care of the butler, who had little trouble in learning to operate it.

In conclusion, Mr. Goddard stated that the demand for a refrigerating machine of a capacity of from 500 pounds to 3 tons of ice is an unquestioned fact; the practicability of such machines now in the market has been demonstrated, and there is no doubt that a large and profitable load for the operation of such machines can be secured by central stations. In Philadelphia alone there are more than 10,000 retail stores which could use small refrigeration machines with an advantage and profit to themselves.

CURRENT NEWS AND NOTES.

THE NEW ATLANTIC CABLE.—A special dispatch of October 2 from Canso, Nova Scotia, says: "The steamship *Colonia*, which is laying the new transatlantic cable of the Commercial Cable Company, reported to-day that about four-fifths of the entire distance had been successfully covered. Up to noon to-day, 1,778 miles of cable had been paid out, although the steamship was only about 1,500 miles in a straight line from her starting point at Canso. The *Colonia* then had more than 300 miles to steam before reaching the coast of Ireland, where the European end of the cable will be landed. Fine weather and a westerly breeze were reported by the *Colonia*."

WIRELESS TELEGRAPHY FOR SURVEY WORK.—To facilitate the survey work of the Grand Trunk Pacific Railway, now in progress in northern Ontario and Quebec, it has been decided to utilize wireless telegraphy for the purpose of communicating with the survey camps. At the present time it takes five or six weeks to send a communication to some of the engineering parties in the field and receive an answer from them. The first wireless station will probably be erected at New Liskeard and another in the vicinity of Lake Abitibi. From the latter point, east and west, there will be wireless offices established at distances of forty or fifty miles apart.

NEW YORK LIGHTING.—Some idea of the expected rapid development of electric light and power on Manhattan Island may be formed from the fact that even before its big Waterside Station No. 2, recently described in these pages, has gone into operation, the New York Edison Company has bought a tract of land at the upper northern extremity of the Island. The land includes 30 lots and is bounded by Academy Street, Two Hundred and First Street, and the Harlem River. This is a splendid strategic location for a new power plant in the future, to supply the territory now developing so rapidly along the banks and bluffs of the Harlem, and shows how closely the energetic management of the company is studying its problems not merely of to-day but those of five and ten years hence.

WIRELESS IN WEST INDIES.—U. S. Vice-Consul Mitchell, of Georgetown, Trinidad, writes that the people in the island are dissatisfied with the present methods of transmitting cable messages. He says: The West India and Panama Telegraph Company, which is paid an annual subsidy of $21,600, subject to deductions pro rata for interruptions, keeps this colony in telegraphic communication with the outside world by means of a cable between here and Trinidad, but this line has become unserviceable, and is so often broken, sometimes for weeks together, that the business community has become intolerant of the uncertain service. The feeling is therefore strongly in favor of any system of wireless telegraphy that would be "fairly reliable," and it is the intention of the Government to offer a reasonable annual subsidy to any one who will undertake such a service.

ELECTRICAL CONVENTION.—In Kansas the eighth annual convention of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Kansas City, Kan., at the Mercantile Club House, on October 13 and 14. Mr. R. C. Johnson, of Lawrence, is president, and Mr. J. D. Nicholson, of Newton, is secretary-treasurer. The programme prepared is as follows: President's address, R. C. Johnston; "The Tantalum Lamp," Prof. B. F. Eyer, State Agricultural College; "Producer Gas," R. M. Sutton, Wichita, Kan.; "The High Efficiency of High C. P. Lamps," J. F. Schaefer, Kansas City, Mo.; "The Need of Sewage Disposal Plants in Kansas," R. E. McDonnell, Kansas City, Mo.; "Co-operation in Management of Gas, Water, Electric Light and Street Railway Companies," C. R. Maunsell, Topeka, Kan.; "Public Utilities and Municipalities," Prof. E. H. S. Bailey, University of Kansas; "Purification," E. S. Springer, Leavenworth, Kan.; "Relative Heat Producing Values of Natural Gas, Oil and Coal," Prof. Erasmus Haworth, University of Kansas; Report of Committee on Revision of Constitution and By-Laws.

STATUE OF GRAMME.—A statue of the late Zenobe Gramme will be unveiled in Liege Oct. 7. Commemorative addresses will be delivered in the afternoon in the Festival Hall of the Electrical Exhibition now in session at Liege.

ELECTRIC LAUNCH FOR NAVY YARD.—An electric launch is being built at the Charlestown Navy Yard, Boston, Mass., for experimental purposes and for practical work. The launch is 28 ft. long and will derive its power from storage batteries. Its speed will be 9 miles per hour.

THE MEXICAN TARIFF.—Many articles of American manufacture are affected by the increase of import duties made by the Mexican government, and which became effective September 1. The duties are based upon the weight per kilo of 2½ pounds. The gross kilo includes the entire packing or casing, and the legal kilo is that prescribed in the traffic act. The rating on electric lamps per gross kilo is 11 cents.

ELECTRIC SMELTING IN CANADA.—The Dominion government is making preparations to conduct experiments at Sault Ste. Marie in electric smelting of ores and the making of steel rails. The furnace is already constructed, and the transformer ordered from the Westinghouse Company for transforming the high voltage current to one of low voltage, is already on the way. The electrodes have been purchased in Sweden.

MORE PACIFIC CABLE.—Mr. George G. Ward, vice-president of the Commercial Cable Company, sailed for New York last week on the White Star steamer Cedric, having completed arrangements for extending the Pacific cable to China and Japan. Clarence H. Mackay, president of the Commercial Cable Company, states that the new cables, both to China and Japan, will be laid and in operation on or before April 1, 1906.

INDEPENDENT TELEPHONE OFFICIAL SHIELD.—The National Interstate Telephone Association has arranged to handle the standard toll sign and other supplies bearing the official shield in order to furnish the same to independent telephone people throughout the country at the lowest possible prices. It is the desire of the association to educate telephone users, and the public generally, to the significance of the official shield as the emblem of independent telephony.

THE DENVER CONVENTION.—Although the entertainment and hospitality extended to the National Electric Light Association last June at Denver and Colorado Springs was most lavish, and left nothing wanting, it is interesting to note that Mr. R. B. Sullivan, chairman of the local finance committee, has returned to the contributors to the fund, 15 per cent of their subscriptions. This is much better than the usual shortage.

LONG-DISTANCE TELEPHONY.—Advices from Boston say: "The American Telephone & Telegraph Company is laying a hundred-pair underground cable between New York and Philadelphia. The underground cable system will in the near future be put in from New York to New Haven and from Boston to Providence. Electrical conditions may soon be overcome that will permit the use of underground cables all the way between Boston and New York. Telephonically speaking, the new telephone repeater of the American Telephone Company will bring Chicago 500 miles nearer to New York."

INDIANA INDEPENDENT TELEPHONE ASSOCIATION.—This association, through its secretary, Charles S. Norton, has just issued a pamphlet describing the plan of organization, giving the operating rules adopted and some gratifying facts and figures on the independent telephone companies of Indiana. The pamphlet shows that there are 368 independent telephone companies in the State, 15,000 stockholders, 175,000 subscribers, 30,000 miles of toll line, 1,560 toll offices, $15,000,000 of capital invested, and that the gross earnings of last year were $3,500,000. The uniform system of accounting is explained and the objects of the organization now being perfected are set forth as being the improvement of the service, standardization of equipment, unification of operating methods, the harmonizing of interests, decrease of expenses, and the increase of the value of telephone securities

TRAIN LIGHTING SYSTEM.—In order to prevent the electric lamps of a single car of a train from being extinguished when the trolley conductor of that car loses contact due to coming upon a dead section, Sigvald Krohn, of Berlin, Germany, according to a patent issued September 26, would arrange the lighting circuits of a train so that at least a portion of the lights upon each car may receive current from the trolleys of a plurality of cars. The lights of each car are divided into independent groups, one of which is connected to the local trolley conductor and another to the trolley conductor of an adjacent car. By this means, failure of current upon one car operates to extinguish only a portion of the lights of any one car, or a portion of the lights on several cars.

POWER OF NIAGARA FALLS.—In a recent ruling in favor of the right of the Niagara, Lockport & Ontario Power Company to acquire certain lands, Referee Love, of Buffalo, made some interesting statements about the effect on the cataract of power development. He says that the development of 200,000 horsepower at Lockport will not endanger the Niagara River. The diversion of 4,500 cubic feet of water every second by the Lockport company, at the point where it proposes to divert the water would not lower the level over the American falls to exceed one inch; and that the diversion of 9,000 cubic feet every second would not lower the level over the American falls to exceed three and one-tenth inches. He adds that the lessening of the depth of the Niagara River from three to six inches would have no injurious effect upon its navigation, as the shifting winds often produce equally as great, if not greater, diminution of its depth.

NO CONFISCATION.—An interesting instance of protecting a corporation is thus noted by the *Wall Street Journal:* "The railroad commissioners of Massachusetts have authorized the Boston & Northern Street Railway Co. to abolish the giving of transfers in five towns and cities along its route. The commissioners in reaching this decision acted upon the principle that the doing away of these transfers was necessary to enable the company to earn fair dividends. The Boston & Northern earned last year only 2 per cent on its stock. This is a notable instance of action by a government board in behalf of vested interests. It stands out in striking contrast to the policy of the Texas Railroad Commission. Government control of railroads ought never to mean confiscation, either direct or indirect. It ought never to result in regulations regarding either rates of transportation or methods of operation which would involve the sacrifice of the capital vested in the enterprise. The ideal government regulation will stand, not for the railroads as against the people or for the people as against the railroads, but for both the railroads and the people, so that each may have fair play."

GERMAN LOCKOUT.—A cable message from Berlin, of September 30, says: "A lockout in three of the largest electrical companies in Berlin began this afternoon. It affects all the factories of the Allgemeine, the Siemens-Halske and the Siemens-Schuckert companies, except one lamp factory, and throws about thirty-three thousand workmen out of employment. As yet the trouble has not affected the entire electrical industry, but it shows signs of spreading. The employes of the Berlin Electrical Works, which generates nearly all the electricity consumed for power and traction purposes in Berlin, met this evening to consider a sympathetic strike, but deferred action until Sunday night, in order to await the result of a conference to be held on Sunday morning between the three companies affected and their employes. This conference will be presided over by Herr von Schultz, president of the Government Arbitration Bureau, but will have no official character, as the companies refused to take part in the appeal for arbitration. They agreed, however, to meet the labor representatives. The engineers of the Berlin Electrical Works, fearing a sudden strike, are spending their entire time in the shops. The office force is also being held in order to operate the machines in case of emergency. Suspension of work in these shops would stop every street car line in Berlin, and the authorities are taking precautions. It has already been arranged to bring a detachment of machinists from the navy yard at Kiel. The lockout this afternoon was effected in good order. The police department offered to increase the police force about the shops, but the managers declined the offer. The companies desired to retain 10 per cent of the workmen in order to complete pressing contracts, but the men refused to stay."

NEWFOUNDLAND TELEGRAPHS.—The premier of Newfoundland, Sir Robert Bond, has made arrangements for a loan of $2,000,000, the proceeds of which are to be paid to Mr. R. G. Reid for the telegraph lines of the colony. The rate of interest on the loan is to be 3½ per cent.

THE TROLLEY IN MANILA.—Secretary of War Taft in his report on the present conditions in Manila, says: "The most noteworthy change is the construction of the electric street railway along thirty-three miles of the streets of Manila. It is a paying property, greatly patronized by the natives, and has revolutionized living in the city."

A CORRECTION.—In the review notice of the book on "Radioactive Substances," by Mde. Sklodowska-Curie, printed last week, an omission by the printer partly destroyed the sense of a sentence. The sentence should have read as follows: "Our views of matter are undergoing a rapid process, not of evolution but of revolution; the element of the chemist is no longer that of the physicist; the one-time indivisible entity is now mercilessly shattered into fragments in order to satisfy the requirements of $\frac{e}{m}$ (peace to the shades of Dalton!), and the stability of the atom as well as the permanence of the various forms of matter are beginning to disappear from the articles of our scientific creed."

LOWER TELEPHONE TOLLS.—Following their reduction of rates in Manhattan and Brooklyn last spring, and more recently in The Bronx, the New York Telephone Company and the New York and New Jersey Telephone Company now announce that a new schedule of discounts is to go into effect on October 1, 1905. The discount will be allowed on toll messages when contracted for in advance, sent from any subscriber's station, in any exchange district of the city of New York, which includes all the boroughs, to all other stations in any other designated station in the city of New York. The subscriber may also select not more than three stations in the exchange district so designated, and all messages sent from them to his station will be subject to the discount which is as follows: On a guarantee of 25 messages a month, 10 per cent.; 50 messages, 20 per cent.; 100, 30 per cent., and 200, 40 per cent.

EVERY HOTEL LIGHTED.—It was, of course, quite impossible for a man like Elihu Thomson to escape an interview on his return from Europe, and thus the *Boston Herald* has secured some interesting comments from an acute and sympathetic observer of progress. He is quoted as follows in regard to his visit to Spain to see the sun's eclipse, and then to Switzerland: "I did not go out of my way to see or inspect anything electrical, but I was surprised to find such advancement in its application as I observed in Spain. I was not prepared to find obscure and remote points of that country using it to the extent they are. In Switzerland, by reason of the immense natural water power, they have made wonderful strides, and are using it extensively in all its various channels of adaptiveness. The railroads are utilizing electricity generally for passenger transportation. I did not visit a hotel during my trip that was not using electricity." When asked for his views on the electrical status, he said: "Electrical people are not disturbed by any contest with gas; our field is so illimitable, discovered and undiscovered. It may be put in this way: The foundation is laid and upon this the structure must be built, rising stone by stone; some have been fitted and laid, some have been quarried and must be dressed and fitted for their places in the structure, while doubtless, others still must be uncovered and blasted out. It is a proposition of dig, and judging from the accumulation of mail you see here, I shall have to take a hand at it, but that may be counted as part of the price one must pay for a vacation."

Electrical Engineers of the Times.—XXX.

PROF. HAROLD B. SMITH.

Harold Babbitt Smith was born in Barre, Mass., May 23, 1869. His ancestors on both sides were among the early settlers of New England, some being among the earliest graduates of Harvard, and members of the family for over a century and a half have, with occasional interruptions, been engaged in educational work. With the exception of about a year spent in California in 1885, Prof. Smith's boyhood was passed in Barre, where he graduated from the high school and passed a year in the office of his father, a wholesale lumber manufacturer, prior to entering Cornell University in 1887. He was graduated from Cornell with the degree of M. E., in June, 1891, and returned for graduate study the following fall. At graduation he was on the honor list of his class, and while a student was a class officer and editor of *Sibley Journal of Engineering.*

In March, 1892, he entered upon the duties of adjunct professor of electrical engineering at the Arkansas State University and had charge of the development of this new department of the university. From this position he resigned in January, 1893, to join the Elektron Company at Springfield, Mass., where he occupied successively the positions of draughtsman, chief designer and electrical engineer. In the fall of 1893 he again returned to educational work as director of the School of Electrical Engineering of Purdue University, Lafayette, Ind. This position he occupied for three years, during which period the scope of the department was much enlarged, the number of students in electrical engineering more than doubled and the corps of instructors and the equipment greatly increased. In 1896 he was appointed to his present position, that of professor

PROF. HAROLD B. SMITH.

of electrical engineering at the Worcester Polytechnic Institute, Worcester, Mass., where as director of the electrical engineering department he has organized this branch of instruction of the Institute.

While Prof. Smith's work has been principally that of an educator, and his abilities as such have been made evident in the organization and conduct of the electrical departments of Purdue and Worcester Polytechnic, his activities have extended to other fields. During the past twelve years he has served as consulting engineer for a number of clients, in several cases being retained over a period of years. He has also devoted considerable time and thought to experimental investigations with alternating currents of high potential. In 1898 he built a transformer for 175,000 volts, in 1901 one for 500,000 volts, and in 1904 another of 300 kw capacity, which has been operated at over 400,000 volts; this latter was probably the largest high-voltage transformer built up to that time.

Prof. Smith is the author of over forty monographs and contributions to engineering societies and technical journals, and was the revising editor of the electrical terms in the last edition of the "Century Dictionary." At the meeting last year of the International Electrical Congress he presented a paper on high-voltage transformers, and was chairman of the International Group Jury of Awards on Electric Lighting at the St. Louis Exposition. He is a member of the American Institute of Electrical Engineers, the British Institution of Electrical Engineers, the American Society of Mechanical Engineers, the American Electrochemical Society, the National Electric Light Association, the Society for the Promotion of Engineering Education, the American Association for the Advancement of Science, etc.

Electric Operations About Massena.

SAINT LAWRENCE COUNTY, New York, the largest in the State, is second only to Niagara in its water power resources, and probably leads all others in the extent of its mineral deposits. Along the northern boundary of this county the St. Lawrence River flows for 73 miles, passing down Galaps, Du Plats and Long and Little Sault Rapids in its course. These last named rapids represent a fall of nearly 50 ft. in the river along 10 miles of its course,

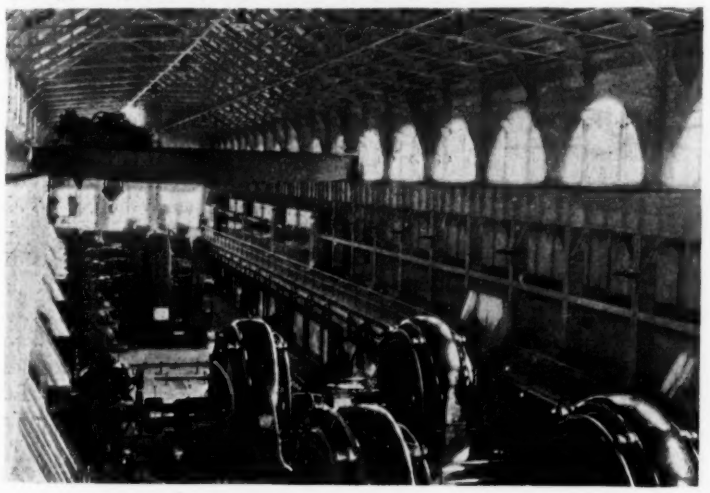


FIG. 1.—INTERIOR OF POWER HOUSE, SHOWING ALUMINUM CONDUCTOR UNDER GALLERY.

which could be developed, but by a curious geographic formation it is practicable to utilize nearly all of this fall by discharging water from the St. Lawrence into La Grasse River through a canal about three miles long. Massena is the site of an electric power plant of 20,050 kw capacity, operated with water from such a canal, as has already been described in our columns.

This interesting plant is owned by the St. Lawrence River Power Company, which has kindly made it possible to present here some facts as to its recent extensions and operations. As the plant is located more than a hundred miles from any of the larger cities of the State, and is in the midst of a territory rich in natural resources, the company has chosen to build up a manufacturing center about it, and to supply energy at attractive rates to industries only a few miles distant, rather than to undertake long transmissions of power. Some of the reasons for this policy may be found in the fact that St. Lawrence County offers an attractive field for the manufacture of paper from wood pulp, and contains large deposits of magnetic and hematite iron ore, and of white and blue marble. In accord with the policy just noted, nearly one-half of the present capacity of the electric station is devoted exclusively to the development of energy for the nearby works of the Pittsburg Reduction Company. Four Bullock generators each rated at 2,200 kw and 500 volts, direct current, supply energy for the company just named, and are kept in operation 24 hours per day and seven days per week with very short

FIG. 3.—ALUMINUM LINE TO PITTSBURG REDUCTION CO.

intermissions for inspection and repairs. Each pair of these generators is direct-connected to the shaft of a single set of horizontal turbine water wheels, as indicated in Fig. 1.

The output of 8,800 kw from the four generators is transmitted from the water power station to the works of the Pittsburg Reduction Company over conductors that have a single length of about 1,500 ft., and are probably among the largest in the world (see Fig. 2). Each side of the two-wire, 500-volt circuit that carries this current of 17,600 amp. is composed of a number of large flat bars of aluminum until a point a little outside of the power house is reached, and then it changes to 250 round aluminum wires, each having a dimeter of ⅜ in. For the support of the two conductors like that just described there are two parallel pole lines with cross timbers between opposite poles, and the aluminum conductors lie directly on the wood at every support. An examination at one or two points failed to show any signs of charring in the wood next to the aluminum wires, and it was stated that no trouble had developed from this cause.

In the works of the Pittsburg Reduction Company the greater part of the energy represented by the 500-volt current is used in the production of aluminum, but quite a portion is consumed as power in the wire-drawing mill. Though aluminum is produced at other points by the Pittsburg Reduction Company, it is said that all of the aluminum wire which is made in the United States is drawn at the Massena plant.

Another important manufacturing industry located near the power plant is that of the Indestructible Fibre Company, which uses eleven motors that aggregate 314 hp, and operate at 440 volts. The Massena Mineral Filler Company uses one motor rated at 1,000 hp and 2,080 volts, and the Remington-Martin Paper Company has a motor of like capacity and voltage. One motor of 20 and one of 40 hp operates the plant of the Simpson-McIntyre Co., and the Massena Machine Works has a 10-hp motor. The St. Lawrence County Electric & Water Company, which distributes electric light in Massena, uses two 25-hp motors to drive machinery in its station.

The most interesting of these power installations is that of the Remington-Martin Paper Company, which is at Norfolk, about 12 miles from the water power plant. At the mills of the Remington Company a 1,000-hp motor is devoted to the unusual if not unique work of grinding logs into pulp. This class of work is one of the

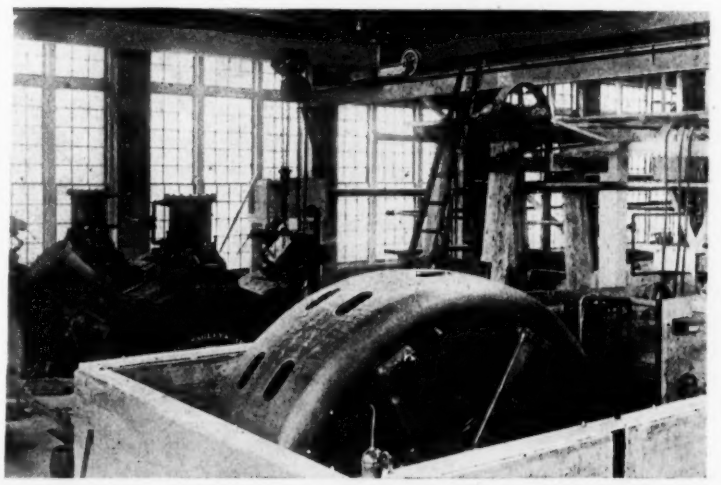


FIG. 3.—INDUCTION MOTOR AT NORFOLK MILL.

heaviest done about a paper mill and is most commonly carried on with direct mechanical connection between the water wheels and pulp grinders. In the mill of the Remington Company, however, the pulp grinders are direct-connected to an induction motor that operates at 2,080 volts, 25 cycles, three-phase and 214 r.p.m. (see Fig. 3). This motor, which is of the General Electric make, drives four wood pulp grinders, two being connected at each end of its shaft. About this motor there is a housing with removable top. This motor is started with an external resistance connected through collector rings on the rotor, and a hand wheel on the motor short-circuits the secondary after the controller is cut out. The grinding of pulp with electric power has been found to be so satisfactory that the paper company is about to adopt it in another mill. It may be noted here that the satisfactory application of electric power to the grinding of wood pulp will result in the location of mills at points where they have not heretofore been thought practicable, because of the lack of cheap power, and will thus materially increase the amount of electric transmission.

In order to economically transmit the energy for this 1,000-hp motor it was necessary to raise the pressure of 2,200 volts generated at the former place to some higher value, and 22,000 volts was selected for the purpose. The 2,200-volt overhead lines run from the generating station to a transformer house a few hundred feet distant, and there connect with three oil-insulated, self-cooling trans-

formers of the Westinghouse make. Each transformer is rated at 375 kw and operates with 1,900 to 2,200 volts in the primary and with 19,000 to 22,000 volts in the secondary windings.

Near the plant of the Remington Paper Company in Norfolk there is a terminal house in which is placed a similar group of transformers which reduce the line pressure to about 2,080 volts for the motor. A single three-phase circuit of aluminum connects the transformers in these terminal houses at opposite ends of the transmission line, which is 11.73 miles long. Each conductor of this circuit is made

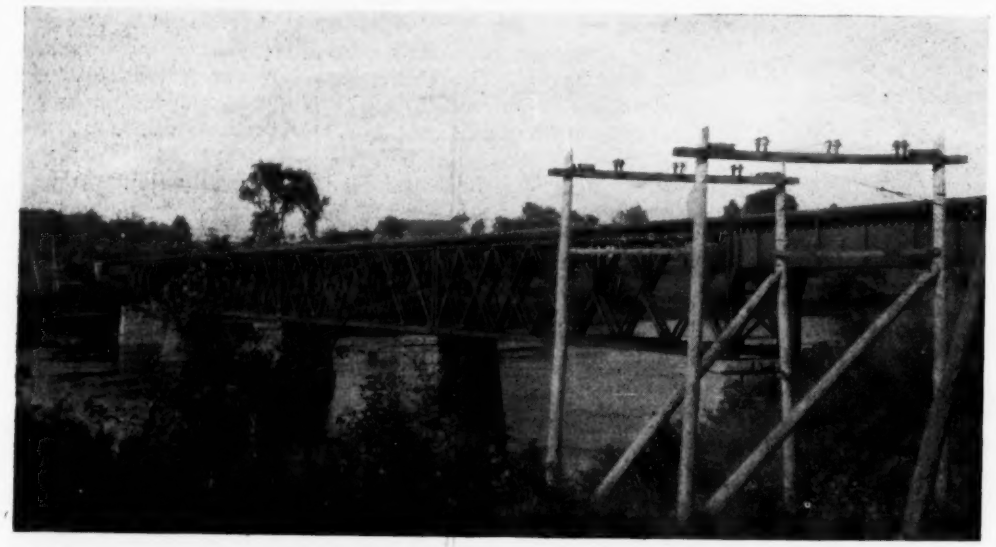


FIG. 4.—RAQUETTE RIVER SPAN ON NORFOLK LINE.

up of seven aluminum wires each 0.099 in. in diameter, so that the cable has approximately the cross-section of a No. 2 B. & S. gauge wire. These three power cables enter the transformer houses through circular openings fully 12 in. in diameter, which are protected from

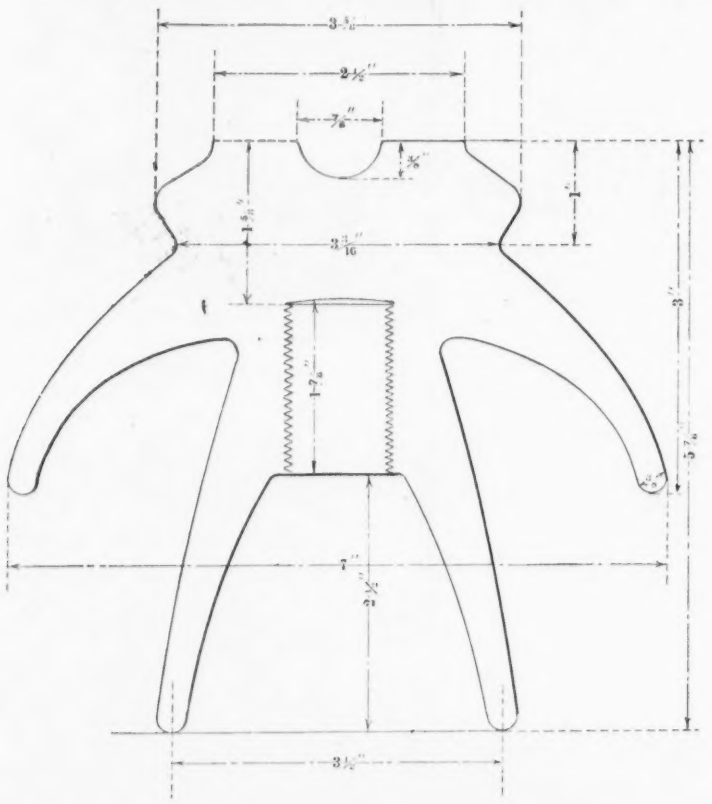


FIG. 5.—DIAGRAM OF INSULATOR.

the weather by a hood in each case. Between the centers of adjacent circular openings the distance is about 4 ft., and this is the standard distance between the three cables along the pole line.

The pole line is built mainly of Michigan cedar poles, each 30 ft. long and having a 6-in. top. Each pole carries one two-wire cross arm for the power cables and the third cable is mounted at the top. At railway and river crossings special timber structures or long poles take the place of the ones of the regular size. Where the transmission line crosses the Massena Terminal Railway a double-pole structure is used on the one side and a tall pole with a special form of guard irons beneath the conductors on the other side. These guard irons are secured at either end of a horizontal bar that is attached to the pole beneath the conductors and parallel with them. Each guard iron resembles a cross arm with its ends turned up, and it is intended to catch any cable that falls from its insulator. In crossing La Grasse River the aluminum cables make a span of 377 ft. between timber structures, and with the temperature at 28° C. the sag of each cable is 10 ft. At the crossing of the Raquette River the span is 515 ft. between wooden structures, but in this case the aluminum cables are supported by two steel cables, each of which is secured to timber struts and passes over wooden saddles on the fixtures that support the power conductors, as shown in Fig. 4.

Each steel cable contains seven strands of wire 0.160 in. in diameter, has a weight of 0.52 pound per foot, an ultimate strength of 9,800 pounds, and a sag of 22 ft. between supports at 26° C. The pair of steel cables carry four cross arms between supports and the aluminum cables are attached to regular line insulators on these cross arms. One-piece porcelain insulators, which are used to support the 22,000-volt circuit, are giving satisfactory results. Each insulator is 5⅞ in. in height, 7 in. in greatest diameter and has a groove ⅞ in. wide for the cable at its top (see Fig. 5). Of the two petticoats on each insulator, the inner extends about 2⅞ in. below the outer and is 3¾ in. in diameter. The depth of pin hole is 1⅞ in., and from the top of the pin hole to the top of the insulator the distance through porcelain is 1⅝ in. At each insulator the aluminum cable is mounted in the top groove and is held by a solid aluminum tie wire 30 in. long of No. 2 B. & S. gauge.

These facts as to electric operations about Massena are presented through the kindness of Mr. E. B. Bumsted, general manager of the St. Lawrence River Power Company; of Mr. R. D. Pierce, and of Mr. Irving A. Taylor, general superintendent.

Three-Wire Electric Railway Systems.

A recent issue of the London *Electrician* contains an interesting account of the Nürnberg-Fürth railway which was converted to the three-wire system some time ago. The financial report for 1904, which recently appeared, shows a substantial gain in favor of the three-wire working. Altogether, the system comprises 19 route miles, and 3,950,000 car miles were run in 1904 against 3,540,000 car miles in 1903. In 1904 and 1903, the receipts were 6.4 d. and 6.5 d. respectively. These figures are based on the assumption that two trailer miles are equivalent to one motor car mile. Some 22.6 millions of passengers were conveyed during 1904, against about 20.4 millions in 1903. In 1904, 3,457,209 kw-hours were generated in the power house, against 3,159,100 kw-hours in the previous year, the generating costs being as follows:

Fuel costs	£5,500	in 1904	and	£5,477	in 1903.
Salaries and wages	1.477	"	"	1,432	"
Lubricating material, etc.	194	"	"	204	"
Maintenance, etc.	1,121	"	"	1,056	"
	£8,292			£8,169	

Hence, the generating costs per kilowatt-hour came to 0.60 d. in 1904, against 0.65 d. in 1903. On an average 870 watt-hours were consumed per car mile in 1904 against 892 watt-hours in the previous year. The corresponding figures per ton-mile are 95 and 97.5 watt-hours respectively. At the end of 1904, the rolling stock consisted of 113 motor cars, 97 trailers, 6 snow ploughs, 3 watering cars, 2 cars for transporting rails and 15 horse-drawn vehicles for various purposes. The total capital expenditure on the tramways, including the power house, was £325,931 at the end of 1904. This system was described on page 1186 of our issue for June 24, 1905.

Armature Reaction in Rotary Converters.

By C. J. FECHHEIMER AND H. A. BERTHOLD.

IF the excitation of a rotary converter be such as to give a maximum power factor, then, if the losses be negligible, there is absolutely no armature reaction. This statement is, of course, based upon the assumptions that the impressed e.m.f. on the alternating-current end follows a sine wave of time-value, and that the rotary is not hunting. The mathematical demonstration of this fact has been given by Dr. Steinmetz, and it may be found in his "Elements of Electrical Engineering," pages 236 to 239. This condition may be seen to follow from the fact that in a synchronous motor operating at its maximum power factor, the tendency of the cross ampere turns (which are the only ones that exist under this condition), is to skew the field in a direction opposite to the direction of rotation; while in a direct-current generator operating with its brushes neutral, the cross ampere-turns tend to skew the field in the same direction as that in which the armature is revolving. Since a rotary converter is a combination of a synchronous motor and a direct-current generator, and since, under the conditions assumed, the resultant ampere turns are equal in value, but opposite in sign, they neutralize each other, and there is, therefore, no armature reaction.

It has now become standard practice to place inductive reactance in series with the alternating current end leads of a rotary and to cause the field m.m.f. to be varied by causing the generated direct current to flow through a series field coil. In such cases the power-factor varies over a wide range, and the conditions cited above no longer hold. It is sometimes important to know just

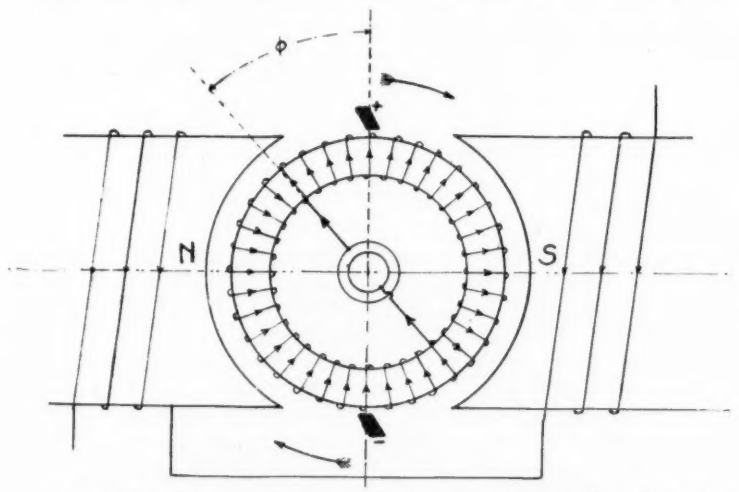


FIG. 1.—ROTARY CONVERTER IN WHICH CURRENT LEADS E.M.F. BY ANGLE ϕ.

how the field is distorted or skewed, if at all, with excitations that give power-factors other than unity, if for no other reason than to be enabled to set the direct-current brushes intelligently. The writers believe that the following synopsis of a theoretical and experimental investigation which was carried out in the electrical laboratories of Purdue University, will prove of interest.

The experimental work consisted in taking flux distribution curves on a four-pole, three-phase, 7½-kw rotary converter. These curves were taken by balancing the e.m.f. induced in an exploring coil wound on the armature against the e.m.f. drop in a resistance, a contact maker being used to close instantaneously the circuit at the proper points. These curves were taken at a number of points on the no load, 1-3, 2-3, and full load phase characteristics, the power-factor being varied from 10 per cent lag to 20 per cent lead, the alternating e.m.f. being maintained constant at 69 volts. A few of these curves have been incorporated in this article.

It was shown by Prof. Blondel in his paper on "Armature Reaction of Alternators," read before the Electrical Congress at St. Louis, that "the armature reaction may be considered as the resultant of a direct reaction produced by the wattless current, $I \sin \phi$, and a transverse reaction due to the watt-current, $I \cos \phi$." Evidently this statement will apply to synchronous motors as well as to alternators. In a rotary, however, a peculiar condition is met with. If the amperes necessary to overcome the losses be neglected in comparison with the much greater load and wattless currents, then at all times will the energy ampere turns of the alternating current be equal to the ampere-turns of the direct current, since, neglecting losses, the same amount of energy is given off at the commutator as is taken in at the collector rings. Hence, as with unity power-factor, the direct-current ampere turns neutralizes the alternating-current energy ampere turns, and thus the transverse or cross reaction is reduced to zero. This simplifies the problem a great deal, as only the effect of the back ampere turns producing the direct reaction, due to I sin ϕ, need to be taken into account.

In a polyphase synchronous motor or generator, the m.m.f. due to

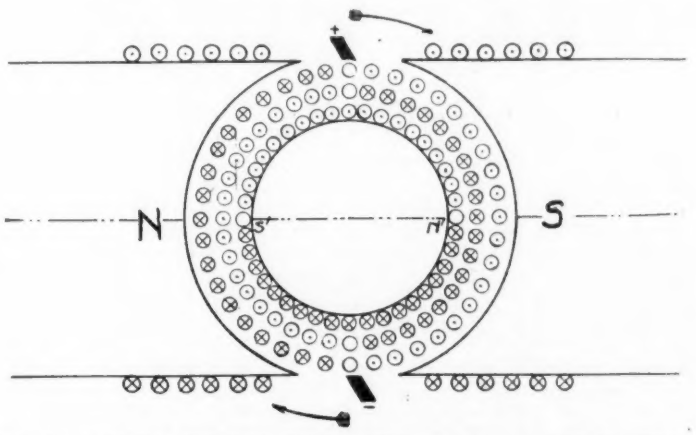


FIG. 2.—LAGGING CURRENT. INNER BELT—I SIN ϕ. MIDDLE BELT—I COS ϕ. OUTER BELT—DIRECT CURRENT.

the current in the armature revolves synchronously with respect to the armature. This m.m.f. is stationary with respect to the poles, and hence in rotary converters the m.m.f., due to the alternating current, stands still in space. As far as polarity due to armature m.m.f. is concerned, the polyphase rotary may be treated as a single-phase machine.

It is customary in dealing with the power factor of synchronous motors to call the terminal power-factor the power-factor of the machine. Due to the local impedance of the armature, however, the angle between the current and the e.m.f. required to overcome the counter generated e.m.f. is not the same as the angle between the current and the terminal e.m.f. In order to simplify conditions, the cosine of the angle between the current and the e.m.f. which overcomes the counter generated e.m.f. will be considered the power factor of the machine.

Fig. 1 is a bipolar representation of a single-phase rotary converter at the instant when maximum alternating current is flowing, which in this case is leading. The angle ϕ is the angle whose cosine is the power factor. Consider in Fig. 2 that the wattless current, $I \sin \phi$, flows in the inner belt of conductors; that the power current, $I \cos \phi$, flows in the middle belt, and that the direct current, Id, flows in the outer belt. It will be seen that, if $I \cos \phi = Id$, their m.m.f's neutralize each other, so that only the effect of $I \sin \phi$, as previously stated, need be considered. In the case of lagging current, as shown in Fig. 2, it will be seen that $I \sin \phi$ produces an m.m.f. which assists

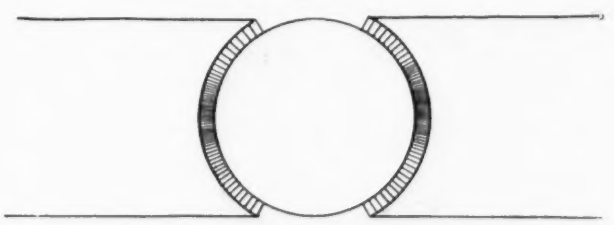


FIG. 3.—DISTRIBUTION OF FLUX IN A ROTARY CONVERTER WITH LAGGING CURRENT.

the field, the poles S' and N' being produced thereby. Due to the distributed form of winding, this m.m.f. increases as the axis is approached. Therefore, the maximum flux density should be along this axis, or directly at the middle of the pole, as is illustrated in Fig. 3. This was found to be the case in the experiments, as is illustrated in the experimental flux distribution curves of Figs. 4 and 6.

The conductors shown in Fig. 7 represent those carrying $I \sin \phi$, which in this case, is leading. Since the armature m.m.f. opposes the field m.m.f. and since this effect is greatest along the axis

there should be a smaller flux density at the middle of the pole than at any other point covered by the pole. Since the armature m.m.f. is less at the pole tips than at any other portion of the armature enclosed by the poles, the flux density should be greater at the pole tips than at any other point, as is shown in Fig. 8. Figs. 5 and 10 illustrate this, although not as well as might be desired, as it was found extremely difficult to obtain accurate results under these conditions.

In the experimental curves illustrated there is a tendency to peak at the leading pole tip. This is believed to be due to the cross-magnetizing effect of the current required to overcome the losses, which in so small a machine (7.5 kw) is not negligible.

From Figs. 2 and 7, it will be observed that $I \sin \phi$ has absolutely no effect upon producing greater flux density in one pole tip than in the other. Hence, there is absolutely no skewing of the field, and, therefore, if the direct-current brushes be set neutral or be given a small forward lead, so that the short-circuited coil may commutate in a field just sufficient to reverse the current, the rotary should run sparkless, regardless of load or power-factor. Experimental curves for various conditions are shown superposed in Fig. 6. In every case they intersect the X axis in practically the same points. Thus we have experimental proof that the neutral point is not shifted by a change in power factor.

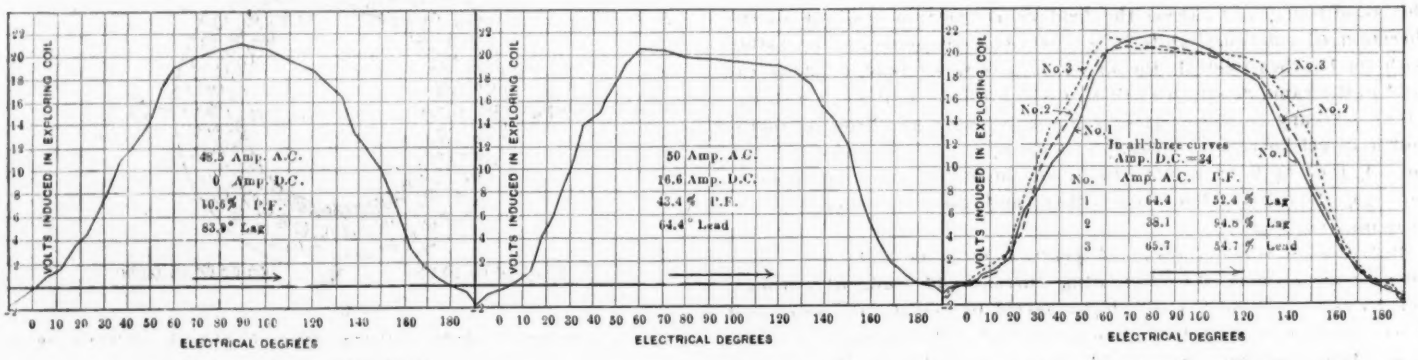


FIG. 4.—FLUX DISTRIBUTION WITH LAGGING CURRENT.

FIG. 5.—FLUX DISTRIBUTION WITH LEADING CURRENT.

FIG. 6.—EFFECT OF CHANGE IN POWER FACTOR ON POLE FRINGES.

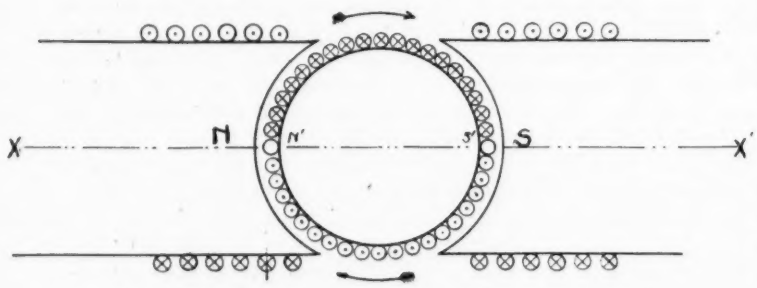


FIG. 7.—BELT OF CONDUCTORS CARRYING I SIN ϕ—LEADING.

It may be shown, by means of a vector diagram, that, for the same terminal e.m.f. and frequency, more flux is required to produce the necessary counter generated e.m.f. with leading than with lagging current. The flux per pole is proportional to the area of a distribution curve, and it was found that the areas of the leading current curves were larger in every case than those for lagging current, thus verifying experimentally that which may be shown theoretically.

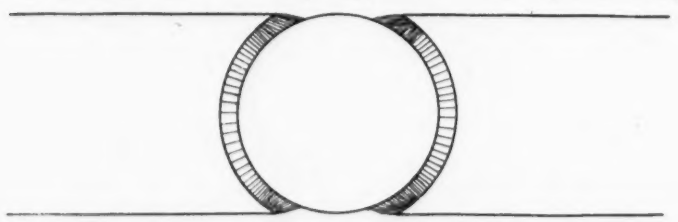


FIG. 8.—DISTRIBUTION OF FLUX IN A ROTARY CONVERTER WITH LEADING CURRENT.

Since there is more flux per pole with leading than with lagging current, and since the maximum density occurs at the pole tips in the former, and at the middle of the pole in the latter, there will be more fringing with leading than with lagging current, as is shown in Figs. 3 and 8. This is also illustrated in Fig. 6, as the sides of the lagging current curve falls within the leading current curve. As a result of this fringing effect with leading current, the range through which the brushes may be shifted without causing sparking, is less with leading than with lagging current.

It will readily be seen that if the rotary be run inverted, the distribution of flux with leading and lagging current will be, respectively, the same as with lagging and leading currents with the rotary running in the ordinary manner.

In case the rotary is used to do mechanical work in addition to its operation as a converter, the flux will be distorted, due to the cross ampere-turns (as in direct-current or synchronous motors) whose value will depend upon the mechanical load applied; and the distribution of flux will depend upon these cross ampere-turns, the back ampere-turns due to I sin ϕ depending upon the power-factor.

Dynamo Iron Loss Increment on Full Load.

BY A. PRESS.

IT is generally conceded that there is an additional iron loss taking place when a dynamo takes on load. The cause of this iron loss is assumed to be due to the flux distortion, in virtue of the armature conductors carrying current setting up a cross flux which compounds with the flux entering from the magnet frame.

Should one investigate the phenomena of superimposition of such fluxes one will arrive at the conclusion that the eddy-current losses can be calculated separately and then added. That is, the eddy-current loss on open circuit of the armature will be ordinary no-load loss; and then, to this should be added the eddy-current loss calculated on the assumption that only the cross flux exists, to give the total iron loss on full load.

The mathematical investigation of this superimposition of eddy-current losses is gone into in a work by the writer on "Dynamo Design," now in course of publication.* The formula, however, for this loss can here be given:

$$\textit{Incremental eddy-current loss} = \frac{262\, f\, (\textit{Volume of teeth})}{(1-f)\, r^2\, \delta^2} \left(\frac{W}{p\, F}\right)$$

Here the loss is in watts and f is the pole-pitch factor, i. e., ratio of pole shoe span to the pole pitch; r is the tooth-pitch ratio, i. e., the ratio of the tooth width to the tooth width plus the slot width; W is the output in watts; p is the number of poles; F is the flux per pole in c.g.s. lines; and δ is the depth of the air-gap in cms. It wlil be seen that only the teeth volume is mentioned. Prof. Ernest Wilson (see *The Electrician*, London, February, 1904) has shown that the iron loss in smooth core armatures is practically independent of the distribution of the flux in the air-gap. Since one can apply the same reasoning for the density in the teeth that one can for the density in the air-gap, it can be taken for granted that there is no incremental core loss.

The above formula does not take into account the additional hysteresis loss. This can be allowed for by multiplying the open-circuit hysteresis loss by 1.2 as an average factor. It will thus be seen why taking an open-circuit test and a short-circuit test gives losses when added rather larger than the actual full-load losses. The bearing friction and windage are added twice and the hysteresis loss is only roughly allowed for.

* McGraw Publishing Company, publishers.

Checking the above evaluation with an empirical formula used by one of the largest European concerns, it is found that there is quite a substantial agreement in the character of the formulæ. Whereas the one can be reduced to

$$\textit{Incremental loss} = D\left(\frac{W}{pF}\right)^2$$

the theoretical formula is

$$\textit{Incremental loss} = \frac{l\lambda}{r\,\delta^2} \cdot D\left(\frac{W}{pF}\right)^2$$

Here λ is the depth of slot and l is the length of core. Checking in this way five machines one arrives at the following:

Size of Machine.	*Empirically derived loss.* / *Theoretically derived loss.*
60 kw	1.64
125 "	2.2
250 "	2.43
500 "	2.65
1000 "	3.32

It is to be noted that the experiments were conducted with a machine of about 50 kw capacity. It was well understood that the above empirical formula was not entirely satisfactory. It gave much too large values for machines of considerable output.

Demonstration Apparatus for Wireless Telegraphy.

BY A. FREDERICK COLLINS.

DURING the past two years the advances in tuned and syntonized wireless telegraph systems have been so marked that simple open circuit transmitters and receivers are no longer suitable for demonstration or experimental purposes, and in order to meet the new conditions the Wireless Telegraph Company, Limited, of Berlin, has placed on the market a small model that covers, in an easily comprehensible form, all the latest improvements.

In this miniature apparatus the high-frequency and high-potential circuits are arranged exactly as they are in the commercial installation of the Telefunken System—as the combined Braun, Siemens & Halske and Slaby-Arco equipments are now known—the only difference being that the instruments have been reduced down to the fewest number of parts and hence their construction is not nearly so expensive. The complete set includes a transmitter with a battery for energizing the induction coil and a receptor with relay and tapper, but with a bell or a sounder instead of the usual Morse register, together with the dual aerial wires and artificial earths.

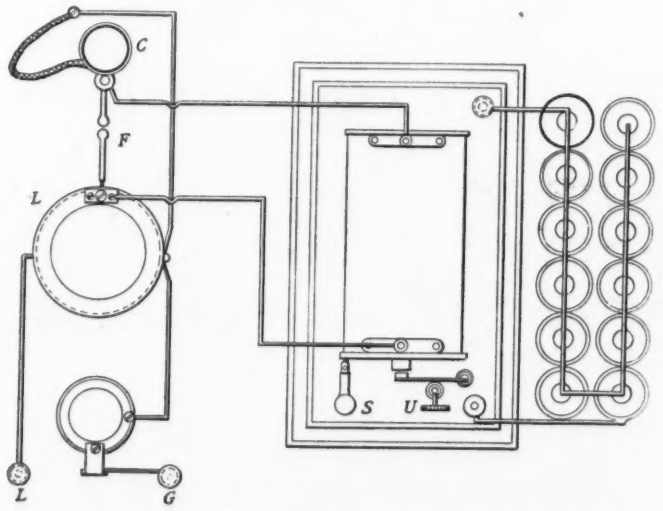


FIG. 1.—TOP ELEVATION OF TRANSMITTER.

By a careful perusal of the following description and a thorough study of the accompanying diagrams a complete understanding of the relations existing between the high and low potential circuits may be obtained. The top elevation, Fig. 1, and the diagrammatic view, Fig. 2, show clearly all the arrangements and various connections of the transmitter and by referring to these it will be seen that the low-voltage direct current from the battery, which gives a current of 1 ampere and 1.5 volts, passes through the primary winding of the small induction coil, W, the interruptor, U, and the key, T, all of which are connected in series.

The terminals of the secondary of the induction coil are connected to the opposite sides of a spark gap, F, through a capacity

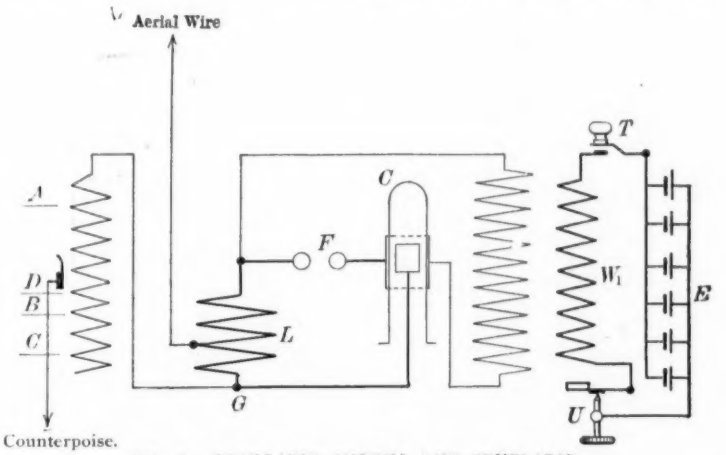


FIG. 2.—OSCILLATOR SYSTEM AND GENERATOR.

formed of a small Leyden jar, C, and these with an inductance coil of fixed value comprise a closed oscillating circuit. The capacity of the jar may be varied within certain limits by changing the relative positions of the inner and outer foils. By this means three different frequencies of oscillations may be set up and, hence, three different wave-lengths sent out.

When the induction coil is in action electric oscillations of high frequency and potential surge to and fro in the closed circuit, and these are impressed on the aerial or radiating system; this consists merely of a hard copper wire about 2 meters in length and having a sheet of copper wire gauze attached to the top. The wire that ordinarily leads to earth is in this case connected to a square of copper gauze, called, according to the German terminology, a counterpoise; the terminal of this and the lower end of the aerial wire are joined together by an inductance coil, L, having three turns of wire, through the medium of a sliding contact.

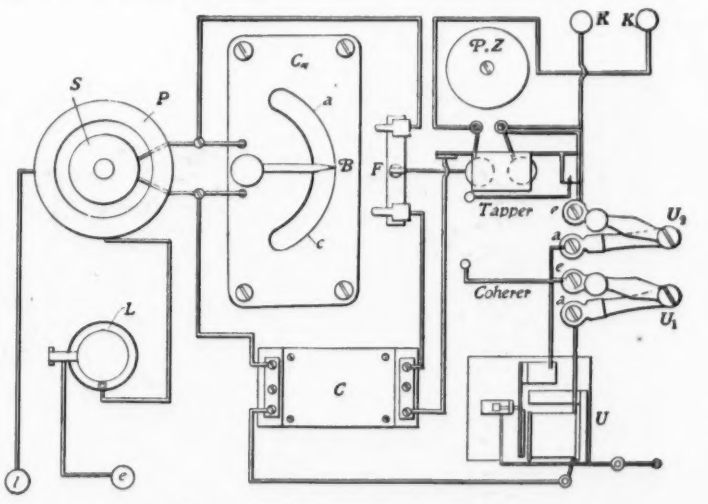


FIG. 3.—TOP ELEVATION OF RECEIVER.

The sheet of copper gauze or counterpoise is connected to the closed circuit at C through a variable inductance formed of a large number of turns of wire wound on an iron core and by changing the value of this inductance, a modification in the wave length of the aerial may be had. Of the three wave lengths which it is possible to produce in this manner, the shortest is obtained when the capacity of the jar is given its smallest value; that is, when the jar is raised high for its guide ring to form its sole capacity and to throw it out of contact with the outer tin foil coating of the jar. When this condition prevails the terminal of the counterpoise

must make contact with the inductance coil at *A* so that the value of inductance will also be cut down.

These two adjustments having been made, the electric oscillations that surge through the aerial will emit electric waves about 30 meters in length. The longest wave is obtained by giving the Leyden jar its greatest capacity, which may be done by bringing the guide ring into contact with the exterior coating of foil and overlapping it by about 2 millimeters.

By connecting the terminal of the counterpoise with the inductance coil at *C*, the resulting wave length will be about 50 meters.

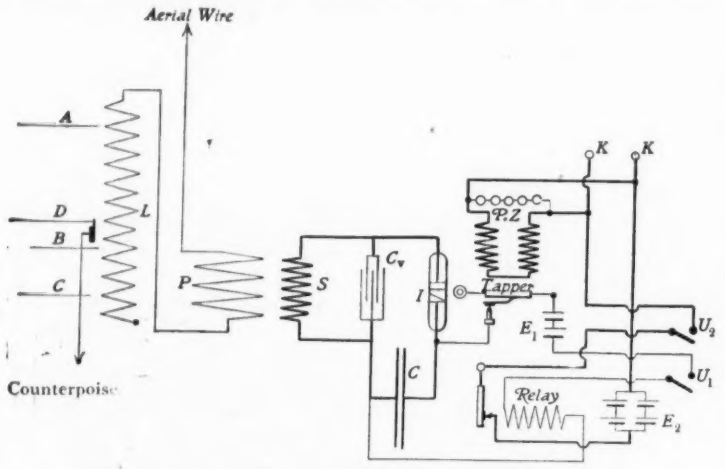


FIG. 4.—RESONATOR SYSTEM AND RECEIVER.

A third and intermediate wave length may be obtained by giving the jar its lowest value and bringing the terminal in contact with the inductance coil at B. Care should be taken that the open and closed circuits are in tune, for the energy propagated by the transmitter is greatest when the oscillating circuits are in resonance.

The receiver shown in the top elevation, Fig. 3, and in the diagram of Fig. 4, utilizes the filings coherer as a detector. When the emitted energy delivered in the form of electrical waves impinges on the antenna or receiving aerial wire they are converted into electric oscillations having the same frequency as those in the sending aerial providing the receiver is in syntony with the transmitter.

Like the open and closed oscillations at the sending station, the receiving resonators consist of a suspended wire with an elevated terminal capacity and of a counterpoise of copper gauze, these being connected through a variable inductance, *L*, and an inductance, *P*, of fixed value, the latter acting as the primary of a small transformer. The primary and secondary of the transformer are wound on a wooden spool, and it is through this mutual induction coil that the open-circuit antenna is coupled with the closed-circuit resonator.

As in the case of the emitting circuits, the maximum energy of the impinging electric waves is greatest when the open and closed circuits of the receiver are in resonance and again when the receiver is syntonized to the transmitter. When these conditions are satisfied the slightest amount of energy suffices to cause the filings of the detector to cohere.

The closed-circuit resonator includes the secondary windings of the transformer, the coherer, *I*, and a fixed capacity, *C*, which is exceedingly large when compared with the inherent capacity of the coherer; the large capacity is introduced so that the capacity of the coherer may be considered negligible when determining the proper oscillation of the closed circuits. Tuning is effected by the variable condenser, *Cn*, which is connected in parallel with the coherer.

The first internal or low-voltage circuit is formed by connecting one side of the coherer to the make and break of the tapper, thence through two small dry cells of 2.6 volts, through the coils of a relay and thence back to the opposite side of the coherer. The second internal circuit includes the armature of the relay, four cells coupled in parallel the terminals leading to *K*, *K*, where either a bell or other indicating device may be connected in; a shunt circuit includes the magnets of the tapper and bridges across the latter is a battery of five polarization cells, which in virtue of their great capacity, prevents undue sparking at the relay contacts. Polarized cells are thus used instead of the choking coils, and these are formed of small glass vessels containing dilute sulphuric acid in which a pair of platinum wire electrodes are immersed.

To tune the circuits and syntonize the receptor with the transmitter, the sliding contacts of the inductance coil, *L*, must be placed at *A B* or *C* as indicated. With this demonstration set, jointed poles that may be easily set up, taken apart and packed in a trunk are supplied; these with their copper gauze capacities may be set in any convenient position indoors, and signals sent and received within the limits of the demonstrating room.

In setting up the apparatus it is only necessary to attach the aerial wires to the terminals marked *L* and the wires from the counterpoises to those marked *G;* but before attempting to transmit signals it is essential that the spark-gap is so adjusted that the discharge will take place when the capacity of the Leyden jar is greatest. The receiver must be adjusted to the highest degree of sensitiveness so that it will respond only to the wave corresponding to the one for which it is tuned. Immediately the operator is through receiving, the switches marked U_1 and U_2 must be thrown open, nor is it advisable for the tyro to make any alterations in the position of the relay or decoherer or to attempt their readjustment.

The theory of syntonization may be beautifully shown experimentally where two sets of demonstration apparatus are at hand, the opposite senders and receivers being tuned to 30 and 50 meter wave lengths respectively. When these sets have been tuned, syntonized and brought to their highest degree of sensitivity, each receiver should respond only to its own transmitter even when the opposing emitter is the nearest.

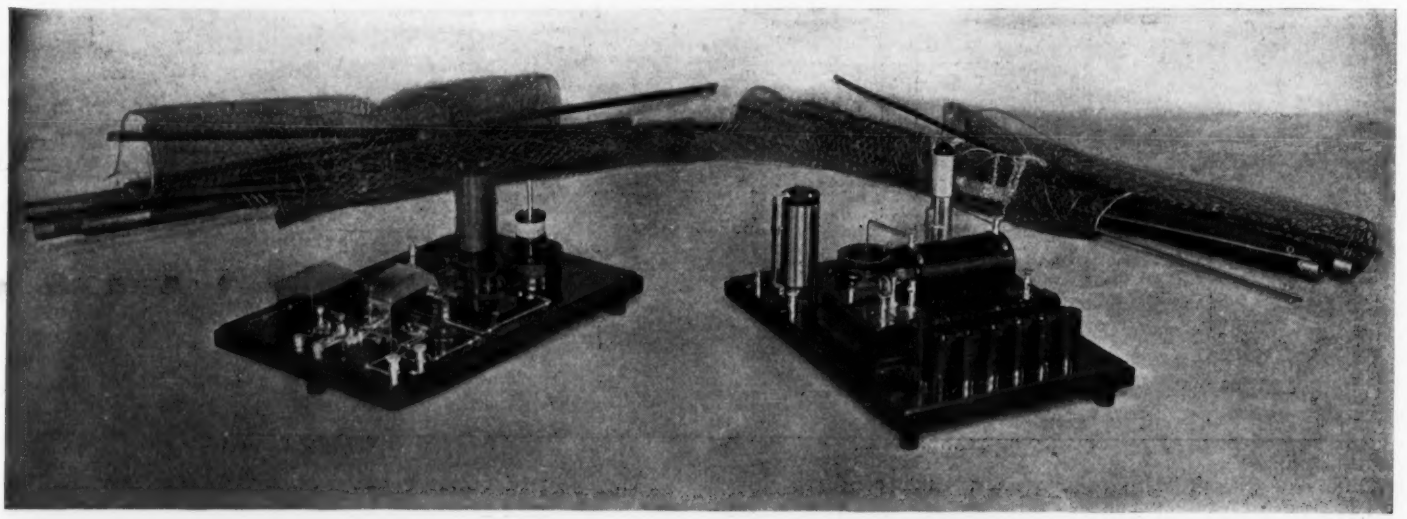


FIG. 5.—COMPLETE APPARATUS READY FOR PACKING.

Where it is desired to send messages to greater distances, an aerial wire at least 15 meters in length, insulated at the top and suspended vertically, must be used, while the opposite terminal may be earthed if a suitable ground is obtainable; or if this is not possible the counterpoise should be used, and in this case it must be in-

sulated from the earth. The instruments are then adjusted so that the transmitter shall have a small capacity and the inductance an intermediate value, the terminal of the earthed wire forming contact with the turns of wire at *D;* the lever of the adjustable condenser in the coherer circuit is brought to the point, *a*, Fig. 3, while the grounded terminal is set at *P* to correspond with the transmitter.

The receiver is then given its maximum sensitiveness by turning the coherer on its longitudinal axis so that the edge of the V-shaped pocket points downward, and also by forcing the secondary coil of the transformer toward the center of the primary winding when all the turns are cut by the oscillatory magnetic field. It is seldom, if ever, that the transmitter gets out of order, but the receiver is more troublesome.

Should any difficulty be experienced, the receiving circuits may

FIG. 6.—DEMONSTRATION RECEIVER SET UP READY FOR USE.

be treated by removing the coherer and bridging the terminals with a bit of wire, when the relay, if it is in fit form, will be set into action. If it operates satisfactorily, then the experimenter may know to a certainty that the coherer is at fault; but if short-circuiting the springs that clasps the coherer does not actuate the relay, then the latter is evidently the source of the trouble and readjustment is necessary.

For out-of-door work care must be taken to keep the aerial wire as far as possible from walls of buildings, trees, metallic objects, such as windmill and water towers, etc.; and where the aerial wires are swung from the top of a house, they should be suspended from a pole 3 meters in length projecting horizontally beyond the wall and attached to either the roof or out of the window, with the aerial insulated from it and drawn away at an angle.

Indoors the signal may be sent for a distance of 50 meters with 3 meter aerials, but out in the open messages may be transmitted and recorded a distance of 500 meters if an aerial 15 meters in height is provided.

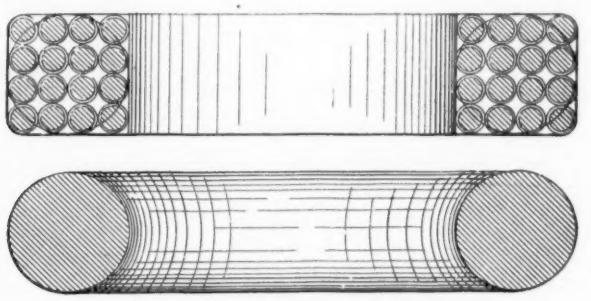
Relation of Pull to Diameter of Solenoids.

BY CHARLES R. UNDERHILL.

IT is well known that when an electric conductor is bent into the form of a circle the magnetizing force at the center of the loop is

$$H = \frac{.2\pi I}{r}, \qquad (1)$$

where I = current in amperes and r = radius of the loop in centimeters; and since the magnetizing force is proportional to the ampere-turns, a group of turns, as in Fig. 1, acting together, and having the same general dimensions as a single conductor, as in



FIGS. 1 AND 2.—DIAGRAM OF COILS.

Fig. 2, produce the same magnetizing force at the center, providing the ampere-turns are the same in both cases. For the group of turns formula (1) would be

$$H = \frac{.2\pi IN}{r}, \qquad (2)$$

where N = number of turns in the group.

In order to determine the effect due to changing the diameters of solenoids, the writer had two sets of windings mounted on wooden spools, the length L of the windings being 1 inch in all cases. Each set consisted of four windings of different diameters. One of these sets had windings of square cross-section, 1 inch by 1 inch, as in

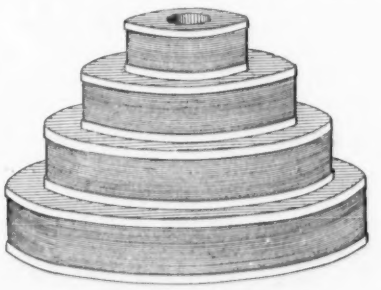


FIG. 3.—THE DISC WINDINGS.

Fig. 4, the mean or average diameters, M, being 4, 6, 8 and 10 in., respectively. In the center of each wooden spool a hole 1 5/32 in. in diameter was bored for the plunger to enter. This set of windings may be called rim windings for convenience.

The other set consisted of windings with varying outside diameters, but with fixed internal diameter, which was 1 3/16 in. in all cases (see Fig. 5). The mean diameters were 2.38, 3.63, 4.63 and 5.63 in., respectively. These windings will be referred to as disc windings.

Substituting $\frac{M}{2}$ for r in (2),

$$H = \frac{.4\pi IN}{M_1}, \qquad (3)$$

where M_1 is expressed in centimeters.

In English measure,

$$H = \frac{3.192\ I\ N}{M}. \qquad (4)$$

The tests were made by the method illustrated in Fig. 6. Here *A* is a magnetizing coil to saturate the core, and *B* represents the winding to be tested. The core was of Swedish iron 1⅛ in. in diameter and 1 sq. in. in cross-section.

First the coil *A* was excited so as to saturate thoroughly the iron core, and then a disc winding was placed over the end of the core in the position of maximum pull and excited from a separate source. Each coil had a rheostat and ammeter in series, the two coils being so connected that attraction would result. Coil *A* was rigidly fastened to the iron core, and the test coil, *B*, attached to the scales. After the core was saturated, a change in the strength of the current in coil *A* produced an almost inappreciable change in the pull, which was accredited to the change in *H;* but when the current strength in coil *B* was changed, the pull varied directly with the strength of the current in coil *B*.

Fig. 7 shows the result of a test of the set of rim windings. This test indicates that the pull due to a solenoid is directly proportional

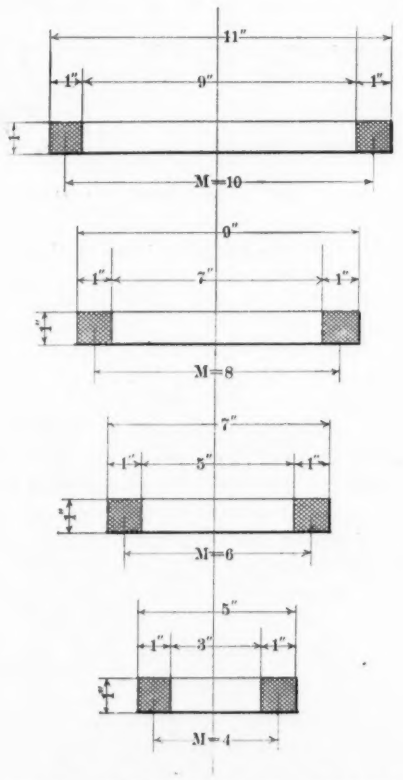


FIG. 4.—DIMENSIONS OF DISC WINDINGS.

to the ampere-turns in the winding after the core is saturated. It incidentally proves the law expressed by (2).

When the disc windings were tested under the same conditions as the rim windings, it was found that the pull was not inversely proportional to the mean diameter of the winding, but nearly inversely proportional to the square root of the mean diameter of the winding. Fig. 8 shows the results of the tests of the disc windings. Although the current varied more or less as the test coil heated, or as the line voltage changed, the curves in Figs. 7 and 8 are very accurate, since the turns were known, and hence the ampere-turns varied directly with the strength of the current.

The dimensions of the rim windings are shown in Fig. 4, and those of the disc windings in Fig. 5. It will be noted that the rim windings were so dimensioned that when telescoped together they would form a perfect disc winding.

The curve from *a* to *b* in Fig. 8 is plotted from Fig. 7, the points being taken from the pulls corresponding to the different mean diameters on the ordinate representing 6,000 ampere-turns. Now the mean or average diameter of a disc winding is not the mean diameter representing the mean strength of field, but the latter is equal to the reciprocal of the sum of the reciprocals of the mean diameters of the squares or groups of turns constituting the disc, multiplied by the number of groups. As an example we will refer to Fig. 7 and note the pull for each of the rim windings under test with 1,500 ampere-turns. The pulls are 1.8, 2.3, 3.2 and 4.8 pounds, respectively, making a total of 12.1 pounds pull for the

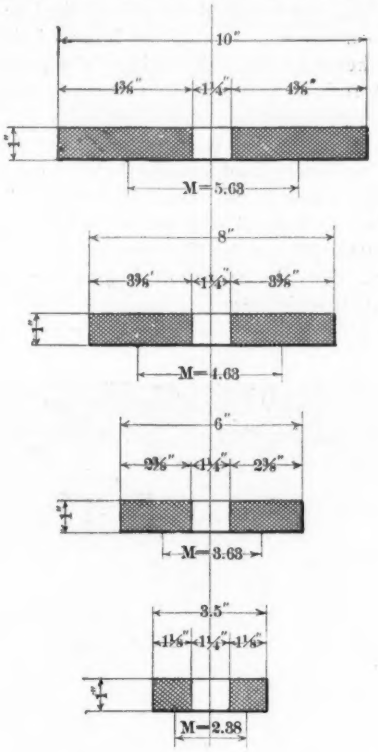


FIG. 5.—DIMENSIONS OF DISC WINDINGS.

four rim windings, with a total of 4 × 1,500 ampere-turns = 6,000 ampere-turns.

Now consider these solenoids telescoped so as to form a disc wind-

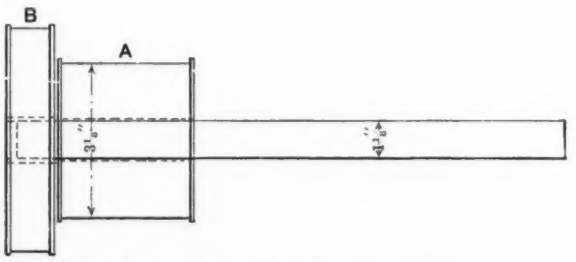


FIG. 6.—DIAGRAM OF TESTING APPARATUS.

ing as in Fig. 10. The mean or average diameter of the winding is 7 in., but the mean diameter representing the mean strength of field is

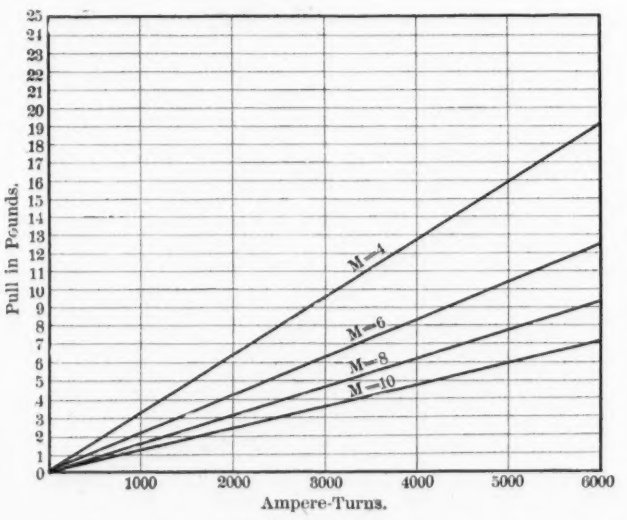


FIG. 7.—TEST OF RIM WINDINGS ON MAGNETIZED BAR.

$$M_e = \frac{n\ (a\,b\,c\,d)}{(a\,b\,c) + (b\,c\,d) + (c\,d\,a) + (d\,a\,b)}, \qquad (5)$$

where n is the number of groups of turns and a, b, c, d the relative mean diameters of the groups.

Therefore, in the case under discussion,

$$M_e = \frac{4\ (4\times6\times8\times10)}{(4\times6\times8)+(6\times8\times10)+(8\times10\times4)+(10\times4\times6)} = \frac{7{,}680}{1{,}232}$$

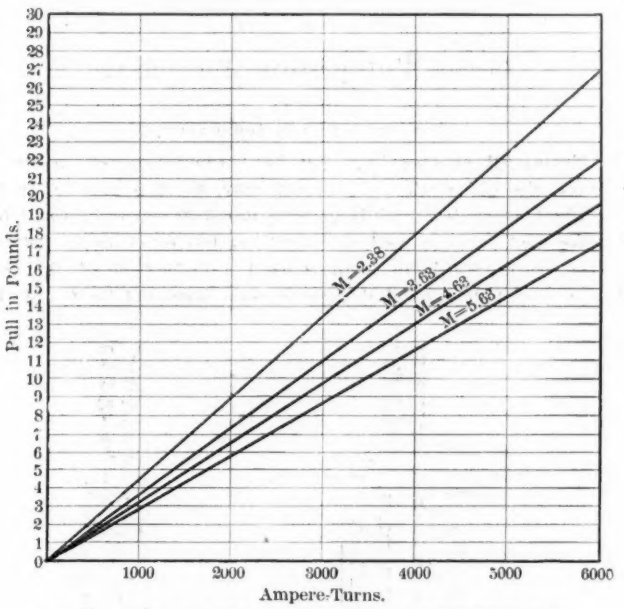


FIG. 8.—TEST OF DISC WINDINGS ON MAGNETIZED BAR.

= 6.23, and hence for a mean diameter of 6.23 in. a pull of 12.1 pounds should be obtained with 6,000 ampere-turns in the entire disc winding, since there are 1,500 ampere-turns in each group of turns, and there are four groups. Referring to Fig. 10 it is seen that this

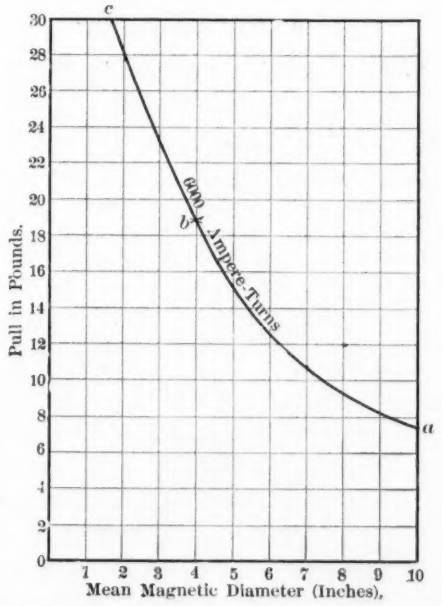


FIG. 9.—COMBINED TEST OF RIM AND DISC WINDINGS.

exactly coincides with the curve obtained from separate tests of the rim solenoids.

By calculating the diameters representing the mean field strength of the disc windings after this manner, the rest of the curve a-c is

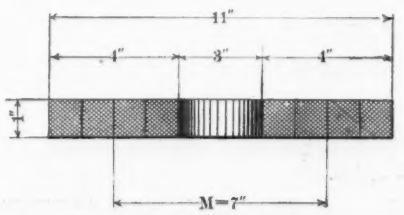


FIG. 10.—RIM WINDINGS TELESCOPED TO FORM DISC WINDING.

obtained, which coincides with, and forms a continuation of, the curve representing the tests of the rim windings.

The curve in Fig. 11 represents the product of the pull times the mean magnetic diameter. This curve is approximately correct; the

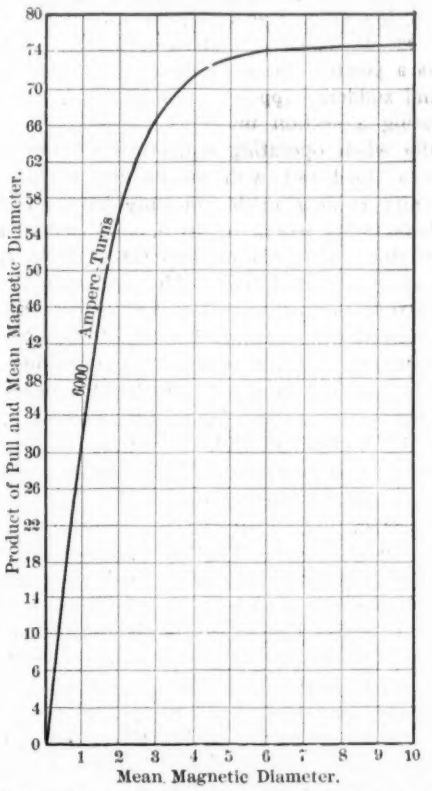


FIG. 11.—PRODUCT OF PULL AND MEAN MAGNETIC DIAMETER.

products below 2½ in. mean magnetic diameter being assumed from the natural slope of the curve.

Electric Railway Equipments.

The paper by Mr. W. B. Potter on "Electric Railway Equipments," read before the American Street Railway Association at its Philadelphia meeting, dealt with the features relating to the development of the past few years. He discussed first the outlook with reference to prime movers, stating that the extent to which the reciprocating engine is being superseded by the steam turbine is indicated by the sales during the past three and one-half years of one type of machine alone, which amount to over half a million kilowatts, of which about one-third are for electric railway service. These figures are mentioned for the purpose of emphasizing the recognized importance of the steam turbine as a prime mover. While the larger sizes of turbines have been more generally used for driving alternators, they are adapted for direct-current railway generators, and turbine sets of this character have been built up to 2,000 kw. The turbine certainly gives great promise of being the only steam-driven prime mover of the future for producing electric power, and its usefulness is by no means limited to that particular field.

Each year bears evidence of the growing popularity of electric traction, and the increase in traffic has naturally affected both the size and weight of the cars and the schedule speeds. The more onerous conditions imposed on the electric apparatus to meet the ever increasing demand for larger and heavier equipments, and the demand for greater seating capacity on systems already operating at 500 to 550 volts, has led to an increase in the generated voltage. We have been accustomed to consider 500 to 550 as the standard direct-current voltage, but 600 volts is now being used to such an extent that it has really become the standard for the power station. The rôle of the manufacturer is to design and construct such apparatus as will best meet the conditions of the operating companies, and it is, therefore, the requirements of the operator that should be studied rather than the development of any particular idea.

The direct-current railway motor has been greatly improved, and has undergone more changes in detail than is perhaps generally appreciated. The old troubles of sparking and flashing at the commutator have been practically eliminated. Previously it was con-

sidered advantageous to shirt-circuit a turn on the field winding to reduce the sparking at the brushes and in the controller, the idea being to restrain the rapidity with which the magnetism of the motor changed, but several years ago it was found that while this provision decreased whatever troubles occurred, due to opening the circuit, it was a positive cause of flashing in case the current was interrupted and suddenly applied. For example, this trouble would occur on passing a section insulator with the controller on, and more especially when operating with sleet on the trolley wire or running over a third rail with an uneven surface.

The field coils as now made not only have no short-circuiting turns, but where metal spools are used, it is customary to split the spool and introduce an insulation into the shell to eliminate every feature of a short-circuited turn. The armature revolutions of a motor as affecting the peripheral speed of the commutator have also an effect on the sparking and wear of the commutator. The armature revolutions further affect the performance of the bearings, and while it would be possible to build a lighter and cheaper motor at higher armature speeds, a maximum of 1,500 r.p.m. appears to be the highest desirable limit as indicated by experience. To meet the requirements of the higher voltage now more commonly used, and to further insure the stability of the motor as regards flashing, it is now the practice to provide a greater number of commutator segments; that is, the voltage difference per commutator bar has been reduced to a lower figure.

The field coils of a motor, although subject to less potential than the armature, by reason of their location in the motor, are more liable to injury from occasional water. A distinct improvement has been made in the construction of the field coils by immersing them in a bath of hot compound under vacuum. The effect of this process is to thoroughly fill all air spaces with compound. This not only renders the coil more waterproof, but also makes it more solid and less liable to injury from mechanical vibration.

The more severe demands of present service have also necessitated changes in the older type of controllers, as well as the development of new types of control and control appliances. The cylinder controllers have been improved by making the arc deflectors of a more vitreous material, less affected by the arc and productive of a much smaller quantity of conducting gas when opening the circuit under abnormal conditions. For the control of equipments aggregating 200 hp and over, the type of control, consisting of electrically operated contactors or switches is being very generally used. It is not only possible to handle heavier currents and a higher voltage by contactor switches, but a further advantage lies in the fact that the master controller occupies considerably less space than a cylinder controller handling the full motor current.

Whether the cars are operated singly or in trains, as the multiple-unit system, the control may be either hand-operated or automatic in its action. In the former case the handling of the master controller is similar to the ordinary cylinder control, and there are controller notches corresponding to each rheostatic step and the series and parallel running points. In the automatic control there are only three positions of the handle, the first one giving slow movements to the car for switching; the other two points are the series and parallel running positions. The intermediate rheostatic points are actuated automatically by a series relay on each car of the train. The automatic form of control is well adapted for services where the rate of acceleration may be predetermined, and need not be dependent upon the judgment of the motorman.

During the past year there have been several installations of alternating railway equipments, and the outlook is very promising for this class of equipment under conditions advantageous to its use. Considered wholly from a technical standpoint, there is no question but that alternating-current motors can perform any service now done by direct-current apparatus, but the choice as between alternating and direct-current should not be made without a full consideration of the direct and indirect expense incident to either type of equipment.

As the street railways and the steam railroads are now becoming so closely identified, a reference to some of the recent tests of the New York Central electric locomotive will not be out of place. This locomotive has now run over 21,000 miles with trains of varying weights. The maximum speed attained with a train weighing 278 tons, including the locomotive, was 71 miles per hour in a distance of about 4 miles. With the locomotive alone, the maximum speed was 85 miles per hour, with the probability that the speed would have been 100 miles per hour had the run been twice the length. The total weight of this locomotive is 97 tons, of which about 70 tons are on the drivers. The nominal rated power is 2,200 hp., although the output during acceleration has often exceeded 3,000 hp.

New Telephone Patents.

NEW SWITCHBOARD APPARATUS.

The design of ringing keys has been revolutionized in the past few years, the old push keys giving way, most generally, to lever keys. The first of these, while gaining much in accessibility of parts, and being well proportioned, occupied far too much keyboard space. Recently all moves have been toward a reduction of this space. In Fig. 1 is shown a good design recently patented by C. M. Hedman, of Chicago, and assigned to the Stromberg-Carlson Co. The operation is self-explanatory. The key shown combines a listening and ringing element. Another device, the patent for which has been assigned to the above mentioned company, is a relay, comprising two elements, the armatures of which are so linked together that the one controls the other. For example, the retractile spring of one armature may hold its own armature in the non-operated position, and the main armature in the operated position. A current in the auxiliary removes its influence from the main, which returns to normal ready to be reactuated by its own coil.

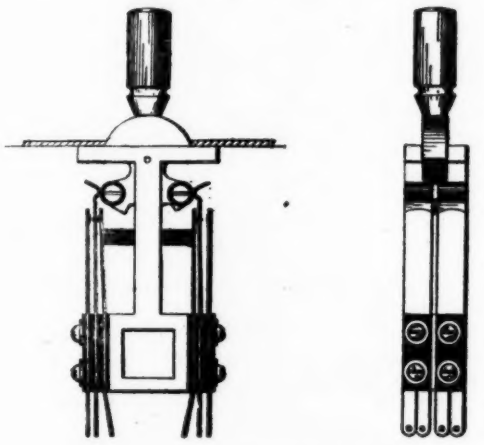


FIG 1.—HEDMAN HANGING KEY.

NEW SUB-STATION APPLIANCES.

Yet a third patent assigned to the Stromberg-Carlson Company is one granted to J. A. Birsfield covering a means for fastening transmitter heads upon desk stands and similar sets. In Fig. 2 is given a sectional view, wherein is shown a spherical lug seated upon

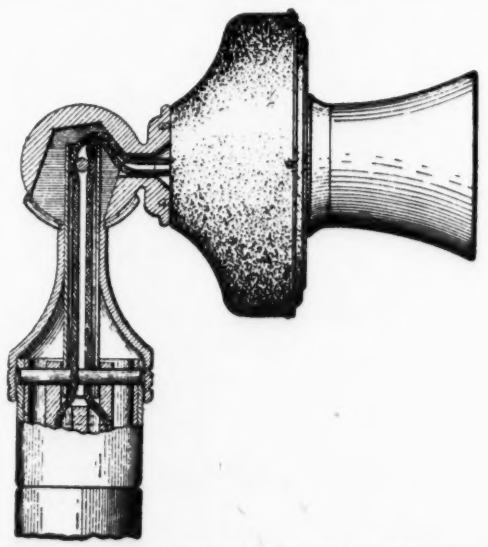


FIG. 2.—BIRSFIELD TRANSMITTER HEAD FASTENING.

a leather cushion on a cup. These parts are held together by a tubular link hinged in an aperture within the sphere.

A. R. Hollander, of Chicago, has invented a metal case hand style receiver, in which a casing and a cup, both of metal, are assembled upon a bridge piece, which supports the magnetic element. This latter is adjustably supported. The diaphragm is clamped by a clamping ring upon which a rubber ear piece is carried.

A pulsating hand generator has been devised by Messrs. E. B. Willix and J. Young, of Mt. Vernon, Iowa, by which either polarity of current may be sent out at will. This is accomplished by a shifting brush which responds to the direction of rotation of the hand crank.

REPEATER.

A new repeater idea has come forward in a patent issued to Béla Gáti, of Hungary, a gentleman who represented the Hungarian government as delegate to the St. Louis International Electrical Congress. In this repeater the arriving currents are made to affect as a slight increment a constant current flowing through a body with a negative temperature coefficient. The increment, if positive, serves to reduce the effective resistance and thus an increase of current larger than proportional is made to flow, thereby giving a multiplied effect which is applied inductively to the transmitting side of the apparatus.

AUTOMATIC SYSTEM CALLING SELECTOR.

Messrs. F. A. Lundquist and J. K. Norstrom, of Chicago, have patented a subscriber's selective calling device for use with automatic systems. The apparatus is too special for detailed description. The claims cover a selector with a number of independently moving toothed discs, all restored by a single common spring.

LETTER TO THE EDITORS.

Pressure Due to Radiation.—Aerial Navigation.

To the Editors of Electrical World and Engineer:

SIRS:—In a book by "D. L. F.", published in Paris in 1775, under the title of "Le Philosophe sans Prétention ou L'Homme Rare," I found a description of a curious contrivance for aerial navigation which is called, p. 30, "Une machine électrique d'une forme nouvelle," and which is operated by *the impact of light*, "percussion de la lumière."

Says the inventor: "Observez que la percussion de la lumière agit actuellement au-dessous de ma méchanique. C'est elle qui va m'enlever sans beaucoup d'efforts," p. 32.

Like the book itself, the machine is one of pure imagination; but, all the same, the expression "Impact of light" is as bold as it is surprising in a work written 130 years ago.

MANHATTAN COLLEGE, NEW YORK. B. POTAMIAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Compound Alternator.—REYVAL.—An illustrated description of a 90-kw compound Heyland three-phase alternator exhibited by the Société Alsacienne at the Exposition at Liege. The principle of the Heyland generator is shown in Fig. 1. The excitation is furnished from the polyphase currents generated in it and supplied to field coils by means of a special commutator. On the other hand the alternator is compounded since the current furnished to the commutator through the brushes is the resultant of the secondary currents furnished by two transformers; the exciting transformer in shunt with the terminals of the machine and the compound transformer in series with it. In the three-phase generator exhibited at Liège these two separate transformers are avoided in the following way: The three-phase exciting currents are produced in three auxiliary coils placed on the stator. In order to realize at the same time the compounding effect, the same slots which hold the auxiliary winding, are also occupied by a part of the main winding which is connected in opposition to the rest of this winding. The arrangement can be seen from Fig. 2 in which *C* is the commutator, *B* the brushes, *s*, the three auxiliary coils placed on the stator and furnishing the exciting current, *S*, the turns of the main stator winding, *S'* that part of the main winding which is placed in the same slots as the auxiliary winding, the windings *S'* being connected in opposition with the rest of the main winding. In this arrangement the auxiliary winding and the part of the main winding placed in the same slots form a compound transformer. As an inductive current has the effect of reducing the field in the main winding its action on the winding *S'* has the inverse sign and increases the voltage of the exciting currents induced in the auxiliary winding *s*. By choosing conveniently the number of the turns in *S'*, it is possible to get the exact compounding. This method of construction is of special interest for machines of medium capacity. It avoids the use of the transformers, the price of which represents a considerable portion of that of the alternator. Moreover, the connections are greatly simplified. The generator exhibited at Liège has a capacity of 38 kilovolt-amperes, and produces three-phase currents at 2,300 volts. For a power factor of 0.8 the current per phase is 22 amperes, which corresponds to a power of 70 kw. The frequency is 50 periods per second for a speed of 750 revolutions per minute. The dimensions of different parts of the machine are given in a table and a detailed drawing of the machine is given.—*L'Eclairage Elec.*, Sept. 9.

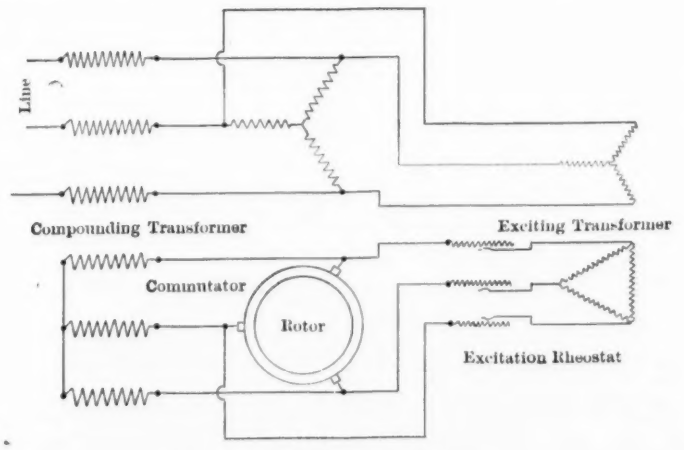


FIG. 1.—COMPOUND ALTERNATOR.

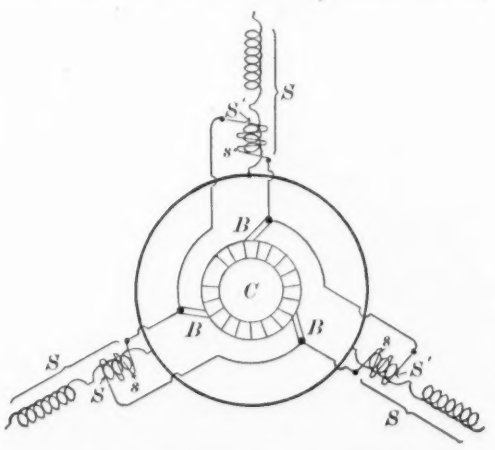


FIG. 2.—COMPOUND ALTERNATOR.

Sparking at Commutators.—Some editorial comments on the recent paper of T. Reid before the Am. Inst. of Elec. Eng. It is pointed out that the belief is still prevalent to-day that it is the spark per se which injures the segment on which it impinges, but others believe that this cannot be the case. It has been noticed that white bright sparks beneath the brushes do not attack the commu-

tator, which still retains its glossy surface; but when the sparks assume a greenish hue the commutator blackens and loses its smooth surface. This latter observation lends color to the theory advanced of late by a few independent workers that the injury to the segments is caused by a volatilization of minute portions of copper, this vaporization being due to an excessive generation of heat in the trailing end of the brushes. Reid's paper shows that the current density may reach enormously high values at certain parts of the rush under favorable conditions. It is assumed by Reid in his deductions that the contact resistance between brush and commutator is constant. This assumption is opposed to the results obtained by a number of experimenters, who found that the contact resistance varied inversely with the current density, so that it was the voltage drop from segment to brush—and not the contact resistance—which remained constant. It must be pointed out, however, that these experiments were made with slip rings, and do not, therefore, apply directly to commutator problems. Considering that carbon has a negative temperature coefficient, it seems likely that the contact resistance is not independent of the current density, but judging from recent researches, it may be reasonably doubted whether it varies strictly inversely as the current.—Lond. *Elec.*, Sept. 8.

Synchronizing Alternators.—Dieny.—An illustrated description of two methods of automatically synchronizing alternators. One method is that of the Westinghouse Company, the other that of Voigt and Haeffner. Both methods have already been described in the Digest.—*La Revue Elec.*, Sept. 15.

Lights and Lighting.

Economy of Arc Lamps.—Hoppe.—A very long discussion of the economy of various types of arc lamps, with special reference to the number connected in series. The author points out that there are a great many different factors besides energy consumption which must be taken into account in determining the economy of a given type of lamp. The author first gives quite a number of tables and diagrams comparing the economy of the different lamps with respect to energy consumption alone. One of his tables is as follows. In order to get 2,000 hefner candles there are consumed (1) with ordinary carbons:

110 volts,	2	lamps in series,		1250	watts.
"	"	3	"	1060	"
220	"	4	"	1575	"
"	"	5	"	1350	"
"	"	6	"	1350	"

(2) with flame arc lamps:

110 volts,	2	lamps in series,		800	watts.
220	"	4	"	950	"
"	"	5	"	1000	"

The author remarks that this result is of interest when lighting installations are planned for towns of medium size. There will be many consumers who can use two or three arc lamps, but not four to six. At 220 volts it is necessary to use a larger number of lamps, whereby the cost of installation is increased; moreover, with the same consumption of energy less light is obtained. Further, it will be seen that the connection of six lamps in series is in no way superior to five lamps. It may be different, however, if in a larger installation a certain number of lamps is prescribed. If 60 lamps are required it will be possible to get more light by connecting six lamps in series than five in series. For instance, 13.2 kw give in such a case 20,000 hefner candles for 10 circuits each containing six lamps in series and each consuming 1.32 kw. The same energy gives 16,800 hefner candles if 12 circuits each containing five lamps in series and each consuming 1.1 kw are used. With enclosed arc lamps the energy consumption is almost always higher; they are superior only for small intensities of light, for instance, below 300 or 400 hefner candles. However, the whole situation is changed if the consumption of carbons, cost of attendance, interest and depreciation are considered. The author finds that for small intensities of light the enclosed arc may be quite economical. The connection of six lamps in series (at 220 volts) is not at all more economical than a connection of five. For small light intensities and short hours of burning, four lamps in series may be more economical than six lamps. With the flame arc four lamps in series at 220 volts are not less economical than five lamps in series. The flame arc lamp is to be taken into consideration only for greater light intensities, like 1,000 hefner candles at 110 volts and 2,000 hefner candles at 220 volts, but for all practical conditions it is more economical than other types of lamps. The superiority of three lamps in series over two lamps in series appears only at longer hours of burning or at greater light intensity. A voltage of 220 appears to be in every respect more uneconomical than 110 for arc lamp installations. Concerning the comparison between alternating-current and direct-current, there is no difference with respect to flame arcs. Ordinary arc lamps, however, when operated with alternating-current (3 in series at 110 volts) consume about 60 to 70 per cent more energy for the same light than with direct-current, three lamps in series, and 40 to 50 per cent more energy than with direct-current, two lamps in series. —*Elek. Zeit.*, Sept. 7.

Illumination of Rooms.—Meisel.—A mathematical paper describing graphical methods for determining the distribution of illumination in a room with different arrangements of a number of sources of light within it. —*Elek. Zeit.*, Sept. 4.

Power.

Irrigation.—Wheeler.—A paper read before the Pacific Coast Eng'ing Congress on the cost of irrigation by electrically driven pumps from transmission service. For small plants capable of irrigating one hundred acres or less, the first cost will usually range from twelve dollars to fifteen dollars per irrigated acre, while the cost of operation will be found to vary from two dollars and seventy-five cents to three dollars and seventy-five cents per irrigated acre. Irrigation by electrically driven pumps is believed to have a very great future.—*Jour. of Electricity*, September.

Textile Mills.—Woodhouse.—A paper read before the Leeds Section of the (Brit.) Inst. Elec. Eng. on the electric driving of textile mills. He first discusses variation of load and gives figures for the power absorbed by various machines. He then speaks in a general way of the advantages of electric driving. For the majority of textile operations constant speed is of vital importance, and it seems that polyphase induction motors are preferable to direct-current machines. The advantages of squirrel-cage motors are many. The only important class of variable-speed machines is found in textile printing.—Lond. *Elec. Eng.*, Sept. 8.

Power Plant Design.—Koester.—A continuation of his illustrated serial on modern power plant design and economics. The author discusses steam engines and steam turbines and the advantages of the latter. He then deals with condensers and auxiliaries.—*Engineering Mag.*, October.

Single-Phase Motors.—Layman.—A paper read before the Pacific Coast Eng'ing Congress. The author gives notes on the latest developments in single-phase motors for commercial power purposes, especially for ventilators, cranes and elevators. The question why a polyphase transmission system should employ single-phase motors is answered by the statement that better combined lighting and motor service can ordinarily be given from local distributing centers over single-phase than over polyphase circuits.—*Jour. of Electricity*, September.

Gas Driven Station.—A fully illustrated description of the electric lighting and traction plant of Walthamstow, which is the largest gas-driven station in England. The engine room at present contains 13 generating sets, each consisting of a Westinghouse three-cylinder gas engine, direct coupled to a direct-current generator. Of this plant, the seven earlier sets comprising four 115-hp and three 250-hp units were utilized solely for lighting purposes; the six latest units are intended three for lighting and three for operating the recently inaugurated light railways. The three traction generators are each for an output of 185 kw at 460 to 562 volts. Gas is generated in 8 producers of the Dowson type.—Lond. *Elec. Rev.*, Sept. 15.

Lignite and Peat for Gas Generators. Zlaman.—A paper on the use of lignite and peat in gas generators for the operation of gas engines.—*Elek. f. Zeit.* (Vienna), Sept. 3.

Fuel Oil.—A continuation of notes on the use of fuel oil on the Pacific coast.—*Am. Mach.*, Sept. 28.

Traction.

Mountain Railway.—Mueller.—An account of a new project of erecting an electric railway to the top of the Zugspitze. The first part of the road has a length of 12.50 km, and is an adhesion railway. The second part is a rack railway. Direct-current at 750 volts will be used. The intention is to arrange the time table so that one car always goes down as another goes up. In this way it will be possible to recover a great amount of the potential energy

from the car running down, and the capacity of the generators will be only 60 per cent of what would be required for running single cars up the hill. There will be provided a battery to be used when no cars run down. The third rail is to be used.—*Zeit. f. Elek.* (Vienna), Sept. 17.

Trolley Head.—A description of a new type of trolley head for electric tramways invented by Blaney. Its object is to reduce the shock when the trolley wheel is passing over suspending ears or other solid parts of the overhead system. The trolley head is shown in Fig. 3; it has the socket which carries the trolley fork, B^1,

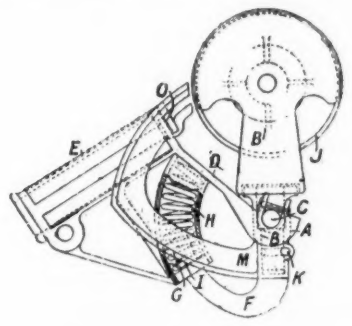


FIG. 3.—TROLLEY HEAD.

pivoted at *C* in a forked extension, *D*, of the pole socket, *E*, to absorb shocks due to unevenness of the wire and to reduce sparking. Two extensions of the pivoted socket are shown, one being the curved arm, *F*, terminating in a shoulder, *I*, which is in contact with a spring or an air cushion in a chamber, *H*, fixed to the arm, *D*, and the other the curved arm, *M*, which terminates close to the periphery of the trolley wheel, J, and also carries two stops, *O*, normally pressed against the pole socket by the spring, *H*. When the wheel, *J*, meets a joint or any other uneven place in the wire, the wheel moves rearwardly on the axis, *C*, and compresses the spring, while the arm, *M*, moves with the socket and prevents the wire or any obstruction from getting between the wheel, *J*, and pole socket, *E*. The spindle, *B*, is grooved, and engages a pin placed in the hole, *K*, thus permitting the trolley wheel, fork and spindle to revolve, but preventing them from leaving the socket, *A*.—Lond. *Elec. Eng.*, Sept. 15.

Philadelphia.—A very full and profusely illustrated series of articles on the tramway systems of Philadelphia; their history, management and equipment. Since the articles cover not less than 84 full pages it is impossible to abstract them briefly.—*St. R'y. Jour.*, Sept. 23 (Convention Issue.)

Electric Railway Dictionary.—A dictionary covering 48 full pages and giving concise descriptions of a very large portion of the principal types of American electric railway apparatus and supplies.—*St. R'y Jour.*, Sept. 23 (Convention Issue).

Automatic Regulator.—An illustrated description of the Thury automatic regulator which is primarily intended to keep the voltage of electric generators constant by regulating the field resistance. Fig. 4 is a diagrammatic sketch of the voltage regulator for alternating-

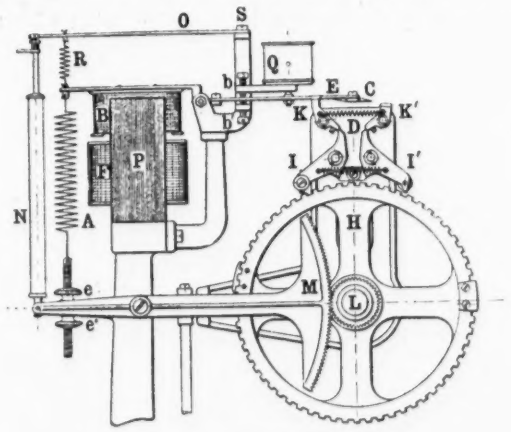


FIG. 4.—AUTOMATIC REGULATOR.

current systems, which is practically identical with that used in continuous-current installations. *H* is a toothed wheel keyed to the shaft, *L*, which carries the switch arm of the rheostat. *D* is a casting, which is rocked to and fro about the shaft, *L*, by a small electric motor of 1/20 hp. The pawls, *I* and *I'*, are attached to *D* in the manner shown, but are held off the toothed wheel by the spring-actuated levers *K* and *K'*. Each of these two levers carries a projection at its upper end; the projection on *K* passes normally above the blade *C*, while that on *K'* rocks to and fro underneath this blade. Consequently, when the blade *C* is lowered or raised in the manner to be described, it will strike against *K'* or *K*, respectively, thus permitting pawl *I'* or *I* to drop into the teeth of the wheel *H*. The latter is now rotated in the one or the other direction, thus cutting in or cutting out field resistance, until the blade *C* regains its horizontal position, when it no longer strikes against *K* or *K'*. Pawls *I* and *I'* are then drawn by spring action out of contact with the teeth of the wheel *H*. The electromagnet mechanism for controlling the position of the blade *C* is as follows: *P* is one of the limbs of the laminations which constitute part of the magnetic circuit through which a flux is maintained by the coil *F*. A very light coil, *B*, connected across the bus-bars whose voltage is to be controlled is free to move up or down above *F*, the movement being limited by adjustable stops, *b* and *b'*. When the voltage of the supply is normal, the current through *B* is such that the lever, *E*, carrying the blade *C* is in a horizontal position and nothing happens. But when the supply voltage is higher or lower than the normal, then a correspondingly larger or smaller current flows through the shunt coil, *B*, which rises or falls in consequence and causes the blade *C* to move into the way of the oscillating levers, *K* and *K'*, thus actuating the rheostat. The coil *B* moves against the tension and compression of the two springs, *A* and *R*, the latter being, in its turn, attached to the free end of a flat spring, *O*, fixed at *S*. The free end of *O* is also in connection through the intervention of a dash-pot, *N*, with the pivoted lever, *M*, which takes up a position in accordance with the position of the switch arm by means of the gearing shown. This arrangement tends to steady the movement of coil *B* and to bring it back speedily to its horizontal position after having been deflected. In order to prevent vibrations of the blade *C* in regulators for alternating current or where the regulation is required to be unusually sensitive, a dash-pot, *Q*, is also provided.—Lond. *Elec.*, September 15.

Lightning Arresters.—BALLOIS.—The conclusion of his long illustrated serial giving descriptions of some new types of lightning arresters; most of them have already been noticed in the Digest.—*L'Eclairage Elec.*, September 2.

ELECTROPHYSICS AND MAGNETISM.

Evolution and Absorption of Gases by Electrodes.—SKINNER.—The author has recently carried out investigations concerning the rate of evolution of hydrogen from the various metals when used as cathodes in an atmosphere of helium, and also its rate of absorption by the anode when the gas filling is hydrogen. It was found that a fresh cathode gives off hydrogen at the same rate as a water voltameter conceived to be placed in series with the discharge tube; that is, the rate of evolution follows Faraday's law for electrolytes. This held with pressures of helium varying from 1 to 3 mm., with currents varying from 1 to 3 milliamperes, and finally with current densities varied from one to six times the normal value for the cathode, and with which also was associated a change in cathode fall of about 100 volts. Then assuming that the evolution in hydrogen was the same as in helium results were given showing that, with the hydrogen filling, the anode absorbs gas also at a rate following Faraday's law. After the current has passed for a time the rate at both cathode and anode falls below Faraday's law. It appeared remarkable that the gas given off by the various cathodes was in all cases hydrogen. Only occasionally was the presence of nitrogen also noted. The author has now investigated if other gases possess in this respect the same properties as hydrogen and he describes experiments showing that nitrogen plays the same part in carbon electrodes that hydrogen plays in the metals. In addition, observations are given showing that a metal as anode also takes up nitrogen.—*Phys. Rev.*, September.

Heat Developed in Dielectrics.—GUYE AND DENSO.—The conclusion of their article in which they describe measurements of the energy dissipated in the form of heat in paraffin when subjected to an electrostatic field revolving with a high efficiency. The results are given in diagrams and it appears that the heat is proportional to the frequency.—*L'Eclairage Elec.*, September 16.

ELECTROCHEMISTRY AND BATTERIES.

Production of Ozone from Oxygen.—FISCHER AND BRAEHMER.—An account of an experimental investigation on the ozonization of

oxygen by ultra-violet light (as given out from a quartz-tube, mercury-vapor lamp). It is necessary to keep the temperature low. At temperatures above 270° C., the reaction changing ozone to oxygen by heat takes place at a greater speed than the reaction changing oxygen to ozone by ultra-violet light. It seems that in the production of ozone by "silent discharges" through air it is really the ultra-violet light produced by the silent discharges which makes the ozone. —*Phys. Zeit.*, September 15.

Alternating-Current Electrolysis.—WILSON.—An account of experiments on alternating-current electrolysis between lead electrodes in sulphuric acid, zinc electrodes in sulphuric acid, zinc chloride, zinc sulphate and sodium sulphate, between iron electrodes in ferrous sulphate and sodium chloride. Some experiments were also made with copper, tin and aluminum electrodes.—*Transactions* Faraday Society, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing High-Tension Insulating Materials.—KINZBRUNNER.—An illustrated account of an investigation in which he determined the conditions for the testing of insulating materials. He investigated especially the shape of the electrodes and the time of the electrification. Fig. 5 gives a time curve for presspahn. It will be seen

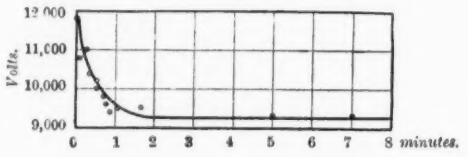


FIG. 5.—INSULATION CURVE.

from this curve that the material is able to resist, for a short time, a voltage considerably in excess of that which it is able to stand for any length of time. This is of great importance, and any material should be subjected to the voltage for at least such a period after which its time curve becomes asymptotic. In this particular case this time is about 1½ minutes. This is called the "time constant." The time constant varies with the quality of the material tested and, although it does not seem to follow any definite law, it increases with the actual disruptive voltage of the material and consequently with the thickness of the latter. The essential conditions to be observed in the test of dielectric strengths of insulating materials are given by the author as follows: The electrodes used should be flat, with round edges, and the actual touching area should be at least 5 sq. cm. The mechanical pressure on the electrode should be at least ¼ kg. per sq. cm. The shape of the curve of the alternating voltage should be nearly sinusoidal; a slight deviation from the sinusoidal shape has, however, little influence on the disruptive voltage. The frequency of the alternating current should be between 20 and 75 periods per second; wherever possible 35 periods should be used. The test should be made in the normal state of the materials: i. e., at a temperature of about 17°, and at a humidity of the air of about 70 per cent. The time of testing should be fixed according to the quality and thickness of the material. The following tables contain these times for a few of the insulating materials mostly used:

Presspahn—1 mm. thick, 4 min.; 2 mm., 6 min.; 3 mm., 8 min.
Paper (not treated)—0.1 mm. thick, ½ min.; 0.2 mm., 1 min.; 0.3 mm., 1½ min.; 0.5 mm., 2 min.
Varnished paper (in one or several layers)—0.5 mm. thick, 2 min.; 1.5 mm., 4 min.; 3 mm., 8 min.; 5 mm., 12 min.
Varnished linen (in one or several layers)—0.5 mm. thick, 2 min.; 1.5 mm., 3 min.; 3 mm., 5 min.; 5 mm., 8 min.
Rubber—1 mm. thick, 1 min.; 2 mm., 5 min.; 5 mm., 15 min.
Gutta Percha—1 mm. thick, 3 min.; 3 mm., 10 min.; 6 mm., 15 min.
Pure Para—1.5 mm. thick, 5 min.; 3 mm., 8 min.
Ebonite—0.5 mm. thick, 5 min.; 1 mm., 10 min.; 3 mm., 20 min.

The procedure for testing should be as follows: The voltage should first be raised to the sparking point, in small steps, and at intervals of about 20 seconds. A new piece should then be taken, and the voltage should be reduced to about 70 to 80 per cent of the sparking voltage; the time which passes between the application of this reduced voltage and the breakdown must be measured carefully. Should this time be less than the time constant, another test must be made with a somewhat smaller voltage; if, on the other hand, the material withstands the voltage for a time which is larger than the time constant, the test must be repeated with an increased voltage, and the time measured again. It is advisable, though not absolutely essential, that for each of these tests a new piece of the material should be used.—Lond. *Elec.*, September 8 and 15. The article is the subject of a long editorial in which the author's definition of the disruptive voltage as that voltage which a material will stand for any length of time is not endorsed. It is customary to test with rising pressures applied for a quarter of a minute at a time, and the voltage at which the material is broken down under these conditions is now recognized as the "disruptive voltage." The time chosen is, of course, purely conventional, but a quarter of a minute being that adopted in the tests issued by the British Engineering Standards Committee should be accepted. The time curves given by the author for various materials are believed to be really temperature curves; i. e., these curves show the decrease in disruptive voltage with the increase of the temperature of the material. This explains the increase of the time factor with increased thickness and with increased dielectric strength. Hobart's suggestion that all materials should be thoroughly dried in a vacuum oven immediately prior to the test should be adopted.—Lond. *Elec.*, September 15.

Practical Standards for Electrical Measurements.—The report presented to the British Association by the Committee on Electrical Standards. It deals especially with the work done on the ampere balance and with apparatus for the determination of "g." The resolutions adopted by the Chamber of Delegates at the St. Louis Congress are given and it is stated that the report relating to the summoning of an international congress on electrical units is now under the consideration of the British Government. "Meanwhile a preliminary conference of representatives of standardizing laboratories and others interested in the determination of electrical units has been summoned by the president of the Reichsanstalt to meet in Berlin in the autumn. Lord Rayleigh and the secretary have received invitations to be present. The object of this conference is stated to be that the institutions which are concerned in maintaining the accuracy of electrical measurements in conjunction with those scientists who have devoted especial attention to this field of work should exchange opinions, and, if possible, come to an agreement as to the measures which must be taken in order to obtain the international uniformity in electrical units and measurements which is desired. It is thus preliminary to the more formal consideration of the subject which would be the work of the international congress." As an appendix is given a paper by Smith on the preparation of the cadmium cell.—Lond. *Elec.*, September 15.

Measuring Slip of Induction Motors.—TIAN.—A brief discussion of several methods for determining the slip of an induction motor and referring especially to stroboscopic methods in combination with an aluminum rectifier and to another method in which the phenomena of rotary magnetic polarization are made use of.—*L'Eclairage Elec.*, September 2.

Electricity Meters.—GERHARDI.—A continuation of his illustrated serial. He describes the demand indicators of Fricker and of Merz. —Lond. *Elec.*, September 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Wires on Power Transmission Lines.—APPLER.—On the twenty miles of line from Kilarc to De La Mar in California a special telephone line construction is used which has proven very successful, both in regard to induction and danger of crossing with the power lines. It is shown in Fig. 6. The main power line is transposed

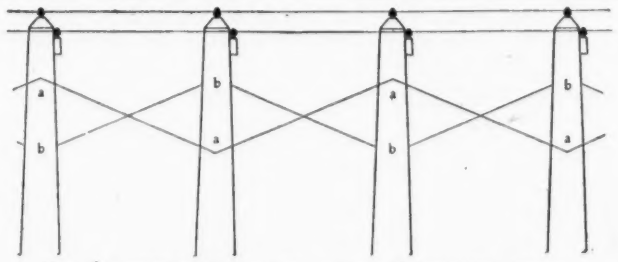


FIG. 6.—TELEPHONE WIRES ON TRANSMISSION LINES.

every three miles while the telephone line is transposed at every power transposition and once between, and at the same time zigzagged up and down from pole to pole. Reference to the sketch will explain this construction. The wires do not cross each other horizontally but vertically. The wire, *a*, is on the one side, the wire, *b*, is on the other side of the poles, changing from one side to the other at transpositions.—*Elec. Jour.*, September.

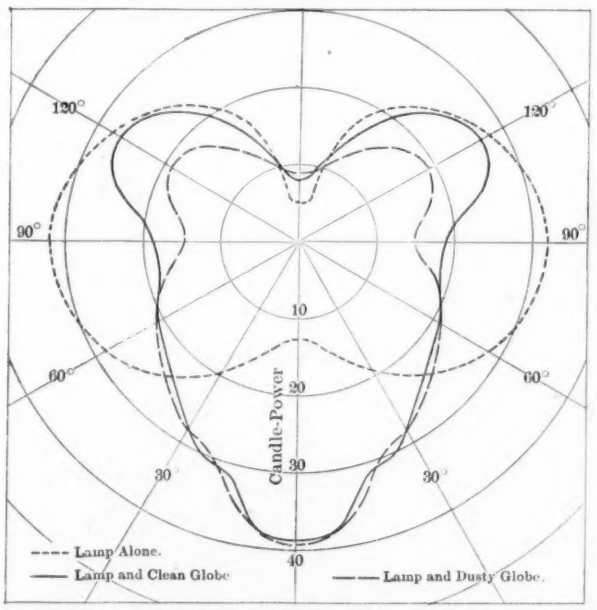
Fire Protection in Telephone Exchanges.—KNOWLTON.—An article giving the various fire hazards encountered in telephone exchanges, what steps are necessary to reduce or eliminate these, and where various fire extinguishing appliances should be located the more readily to be of service in case of need.—*American Electrician,* October.

Absorption of Light by Dust.

BY VAN RENSSELAER LANSINGH.

A short time ago an editorial appeared in your columns relative to the effect of dust on "Holophane" globes, in which it was stated that the effect of dust on such globes was to cut down very materially the efficiency of the same. In order to determine whether this statement was correct or not, a series of tests was made at the Electrical Testing Laboratories. I quote from their report:

"Globe No. 3354 used in this test was about 6 inches in diameter and 6 inches deep, and was of the Holophane type. In order to prepare the globe for this test it was hung pendant for several months



ABSORPTION OF LIGHT BY DUST.

in the position in which it was to be used, allowing dust to accumulate upon its outer surface, with its opening covered, however, to keep the dust from getting upon the inner surface. When a coating of dust had accumulated on the globe, it was removed from its position and tested with a 32-cp oval-filament incandescent lamp. It was impossible to rotate the globe without disturbing the coating of dust, and therefore measurements were made in various vertical planes at each angle specified. Where the coating of dust was thicker on some parts of the globe than on others, it resulted in variations in the apparent candle-power shown in different planes at the same angle. This variation is shown in columns 4 and 5 of the following tabulation. The globe was then removed, thoroughly cleaned, and measurements of the globe used with the same 32-cp lamp were made in the usual manner. The following results were then obtained:

	Lamp alone.	Globe dusty.	Variation in Apparent c.p. Low.	High.	Globe. cleaned.
180° (zenith)	5.4	8.3	...	...	8.1
150°	19.8	12.9	12.4	13.4	15.8
120°	27.5	18.4	16.7	20.2	26.6
90° (horiz.)	32.0	15.1	14.1	16.4	18.2
75°	30.8	18.3	...	...	18.7
60°	28.5	20.4	20.2	20.5	20.8
45°	24.6	24.3	24.0	24.8	23.7
30°	19.5	28.2	28.0	28.6	28.1
20°	16.6	30.4	30.0	30.9	30.5
10°	14.0	36.4	36.0	36.8	36.7
0° (Nadir)	12.9	38.5	...	...	38.2

It will be noticed in examining this test that the light below the horizontal is practically uneffected by the thick covering of dust, and that most of the light absorbed, amounting to 13 per cent, is lost in the upper hemisphere where it is of least value. This is due, of course, to the shape of the globe, as the upper part is where the dust principally rested. The reason that there is so little loss in the lower hemisphere is due to the fact that the upper part of each prism in a "Holophane" globe is mostly a total reflecting surface and on such a surface it is immaterial whether dust collects or not, as far as the reflecting power is concerned. It will readily be seen that such prisms are unaffected, as long as nothing comes in optical contact with the glass, and inasmuch as in the case of dirt, a thin film of air exists between the particles of dust and the glass, the index of refraction of glass and air is unchanged. This is not true of the lower surface of each prism, but on this the dust is much less likely to lodge.

It will be noted in this test that the opening was covered to prevent dust from getting on the inner surface. This should be done in the case of all globes, whether of the "Holophane" type or not, as it is not only a question of dust falling inside of the globe, but also settling on the lamp itself. It may result in a slight decrease in the life of the lamp, but this is more than compensated for by the cleanliness secured.

In a series of tests made by Messrs. Legg & Townsend some years ago at the Chicago Public Library on the desk lamps used there, which consisted of bare lamps with green flashed porcelain shades, it was found that the relative increase of light, after cleaning the shades and lamps, ran in some cases as high as 70 per cent, and averaged 29 per cent. Such tests would show the absolute necessity of keeping the inside of the globes clean (as well, of course, as the outside), and would tend to support the theory that if such a method of procedure slightly shortened the life of the lamp, the increase in illumination gained thereby would more than offset the same. A series of tests is now being made to determine the relative losses in such cases and will be reported upon later.

It will be seen from the above tests that the loss in light, due to dust collecting on "Holophane" globes, is, therefore, a comparatively small amount, certainly not in excess of the loss on ordinary globes. The effect of dust, therefore, on globes is more a question of looks than of efficiency. They should, in common with all globes, be kept clean, which can easily be done by means of a stiff brush. The loss of light, due to such dust, is, however, remarkably low.

"National" Induction Motors.

The National Electric Company, Milwaukee, builders of direct and alternating-current machinery and the Christensen air brake, so well known in the street railway field, is placing on the market a new type of induction motor. The machines are of extremely heavy and substantial construction, and may be installed on the floor, side wall or ceiling by changing the brackets which carry the bearings. Owing to the high speeds at which the machines operate and the small space between stator and rotor, an extremely heavy shaft

FIG. 1.—INDUCTION MOTOR.

is used, while the bearings are of large area, eliminating as much as possible any variation in the air gap.

The frame is made of cast iron, into which are assembled the laminations. The windings are all form-wound by automatic machinery, and between each coil air space is provided to take care of the heating. The ventilation has also been given careful consideration, there being numerous openings provided in the frame, and

also ventilating spaces between the laminations. The rotor is of the squirrel-cage type with copper rods inserted in the slots. This is built up of laminations of mild steel assembled on a spider and held firmly in position by end plates. The bearings are self-oiling and have wearing surfaces of ample proportions.

An auto-starter is furnished with the squirrel-cage type consisting of transformers connected across the line with voltage taps suitable for starting the motor under different conditions of load. A switch construction is provided for throwing the motor from one voltage to another. All of this apparatus is immersed in a tank of oil, which makes it sufficiently reliable to operate at high voltages and which takes care of any heating due to starting under heavy torque.

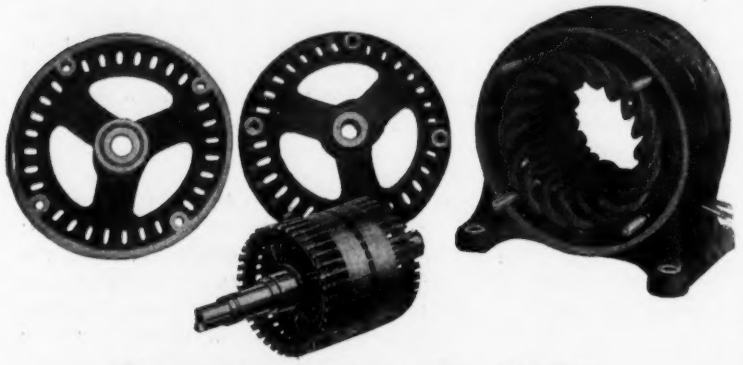


FIG. 2.—PARTS OF MOTOR READY FOR ASSEMBLING.

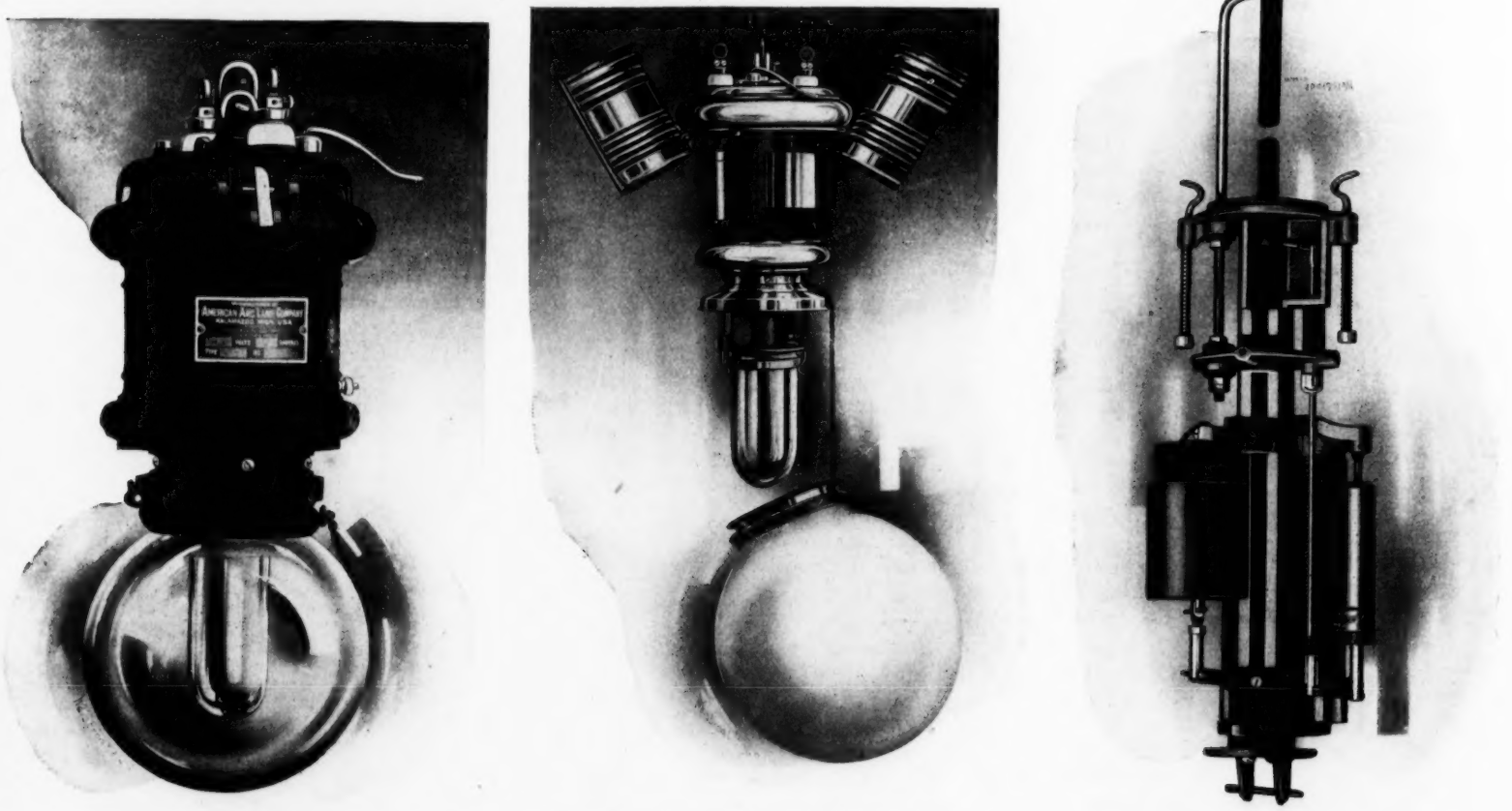
Galvanized Chain for Arc Lamps.

The Oneida Community, Ltd., Oneida, N. Y., is putting on the market a special chain for raising and lowering arc lamps suspended from mast arms. This chain is made in various sizes, to fit any pattern of pulley, and is heavily galvanized. It is claimed that this chain will outwear two or three times any other attachment which has yet been put on the market for this purpose. As the chain is uniform in strength, there is no fear of the lamps falling to the street, as happens so unexpectedly when the strands of a wire cable give way, or a rope has rotted out. The manufacturers state that many central stations have already adopted this system for raising and lowering arc lamps.

"American" Arc Lamp.

The American Arc Lamp Company, of Kalamazoo, Mich., which succeeded to the business of the late Lea Manufacturing Company, of Elwood, Ind., has for the past year been engaged in improving the arc lamp made by the latter company, which had been in successful use for over ten years. For the manufacture of the improved lamp a well-equipped factory has been erected, and is now turning out a large product.

The lamp, which is of the direct-current multiple type, has been especially adapted for use in shops, factories, etc., and its construction is remarkably simple in that there are but five parts. The swinging covers are readily opened without the use of tools and permit access to the interior of the lamp from every side. The magnet coil is practically indestructible, and a self-locking switch is an important improvement. This switch is manipulated by a lever or handle on the top cover as in the Lea lamp, but in the switch itself there is a radical change. When the switch is opened by the ordinary movement of the lever it remains open, locked in position, and no amount of pressure will cause it to fly back or short-circuit. When closed it remains locked in position forming a perfect contact, and is not affected by vibration or rough usage. This overcomes an anoying feature noticeable in the old type of lamp. The difficult problem of great length of carbon life has been solved in a simple manner, the lamps running about 240 hours without trimming. The means employed in securing this result is clearly shown by the cut of interior of the lamp with covers removed.



FIGS. 1, 2 AND 3.—"AMERICAN" ARC LAMP.

Power Development in Wisconsin.

The Western Gas & Investment Co., with headquarters in Chicago, and owner and operator of a number of electric lighting and gas plants throughout the country, acquired some time ago the property of the Stillwater, Minn., Gas & Electric Company. In conjunction therewith it also acquired water powers on the Apple River in Wisconsin, one at Somerset, Wis., approximately 12 miles

from Stillwater, the second one at Riverdale, Wis., approximately 14 miles from Stillwater.

At Somerset the water power had been previously developed and there was in operation an electric plant supplying current to a number of surrounding towns. The electric portion of this plant has been entirely remodeled and there are now in operation two 250-kw, 450-r.p.m., 2,300-volt, three-phase, 60-cycle, belted-type, alternating-current generators with direct-connected exciters.

At Riverdale the company has constructed a concrete dam with power house and have located therein two 250-kw, 200-r.p.m., 2,300-volt, three-phase, 60-cycle, directly coupled to water wheels.

In each of the above stations are located three 250-kw, oil-insulated, water-cooled transformers, which convert the generator voltage of 2,300 volts to 15,000 volts. The two stations, Riverdale and Somerset, which are located two and a half miles apart, are run in multiple with each other, and the combined output is transmitted to Stillwater, Minn., where it is reduced by means of three 400-kw, oil-insulated, water-cooled transformers for use in commercial and city lighting, and also for furnishing a large amount of current for power purposes.

The generators and transformers in each of the stations were manufactured and installed by the National Electric Company, of Milwaukee, and the water wheels in the Riverdale station were furnished by S. Morgan Smith, of York, Pa. The plant has now been in successful operation for some time, and is one of the best designed plants now in the Northwest. Mr. R. S. Feurtado, who is the engineer of the Western Gas & Investment Co., has given the design of this plant his entire attention and its successful operation is an evidence of his very successful supervision.

Thomson High Torque Induction Test Watt-Hour Meter.

To every central station or isolated plant the question of periodical meter calibration is of vital importance, and the customary method of making such tests is by the use of indicating instruments. Although there is no question regarding the accuracy of this method, the rapid growth in the electric lighting and power industry and the more than proportionate increase in the use of the rotating meter as the means of measurement, demand that some way be provided whereby tests may be made more quickly, and yet at the same time without in the least decreasing their reliability. Such a method is

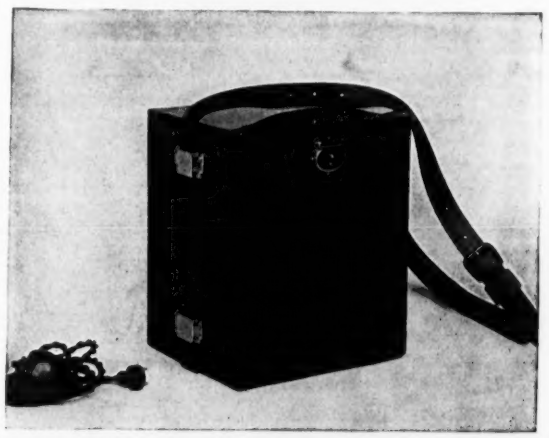


FIG. 1.—CASE FOR TEST METER.

provided by the use of the Thomson high torque induction test watt-hour meter, now placed on the market by the General Electric Company, Schenectady, N. Y.

In using this meter it is unnecessary that the load shall be constant, as the only observations necessary are the number of disc revolutions of the meter undergoing test and the pointer indications of the standard meter before and after test. Both meters integrate the instantaneous values and hence it is unnecessary to obtain the mean value or require an unvarying load. The time saving qualities of this device will be appreciated when it is remembered that no check tests have to be made and a reading, once commenced need not be discontinued on account of load fluctuations. Furthermore, the meter is so designed that one standard may be used for testing meters of different capacities covering a range from light load to full load. This also renders possible more rapid testing as no time is consumed in changing standards. Personal errors of observation are also practically eliminated as all readings may be made with precision. A stop watch is required only in checking the test meter with the primary standards.

The test meter is enclosed in a wooden carrying case provided with a substantial strap to aid in transportation. It is of a convenient size, being 10 in. by 8 in. by 7 in. in over-all dimensions. The cover may be entirely removed from the case for sake of convenience when making tests. It is provided with lock and key for the prevention of tampering by unauthorized persons.

The register, which is very large and easily read, is placed on top, and is of the three-pointer type. The larger pointer reads directly in disc revolutions, and is subdivided into one hundred equal parts, so that it may be read to hundredths of a revolution.

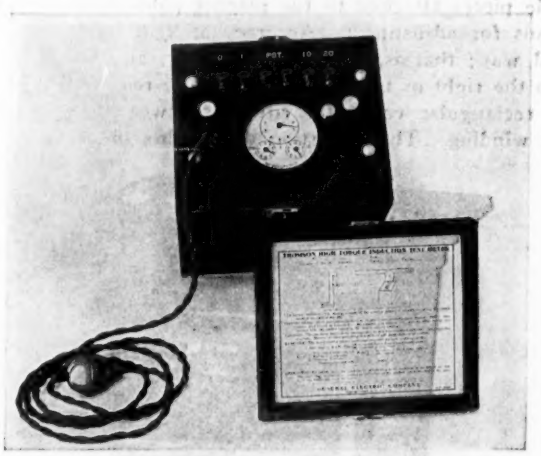


FIG. 2.—CASE WITH COVER REMOVED.

The two other and smaller pointers make one revolution for each ten or one hundred revolutions, respectively. As the full load speed of the meter is less than 35 revolutions per minute, a three-minute test at this load may be made before the indications repeat themselves.

The connections are made by means of binding posts placed at the top. At the left of the dial is placed a plug receptacle in series with the potential coil. To the corresponding plug is attached, by means of a lamp cord, a pendant snap switch, the opening and closing of which stops or starts the meter. The cord is of sufficient length to permit of the test meter being placed at some distance from the operator, which may be necessary, for instance, when the meter under test is installed at such a height as to require the use of a ladder. A little to the right of the dial is placed a knurled thumb nut, by aid of which the moving element may be raised from its jewel bearing and securely locked during transportation.

The cup diamond has been adopted for the lower thrust bearing. The pivot is identical with that used for the ordinary sapphire bearing, consisting of a small piece of piano wire, glass hardened and highly polished, inserted in a removable brass shaft end.

The entire meter may be lifted from the case by two buttons on opposite sides, thus making it easily accessible for calibration. When removed from the case the meter will remain without support in an upright position resting upon the magnet core and central casting, to which all parts are fastened.

The potential winding is suitable for use on voltages ranging ten per cent on either side of the normal. Three current coils are employed, one end of each being connected to a common binding post, and the other ends terminating in each of the three remaining binding posts, which are properly marked for the various ampere capacities of the coils attached thereto. The capacities selected as being the most generally desirable are one, ten and twenty amperes, which are sufficient for testing meters from three to twenty-five amperes normal capacity. The ampere-turns of the three windings are equal, hence the torque is constant when the meter is operating under the same percentage of full load for the individual coils. In other words, when using the smallest winding with one ampere passing, the torque is equal to that produced by the largest coil with a current of twenty amperes. Thus, friction is entirely negligible and accuracy is obtained throughout its range. This feature will be found of the greatest importance when testing meters on

light loads, for no corrections will have to be made for possible errors in the test meter.

High torque is a feature of the meter, and is obtained solely by efficient design. Internal losses are practically negligible, and the moving element is so light that all questions of jewel wear are eliminated. On account of the extremely high torque used it has been found difficult to obtain absolutely permanent magnets of standard design with sufficient strength to keep the full load speed within proper limits. Therefore, a new magnet system has been designed, in which two magnets are astatically arranged, one above and the other below the revolving disc. The pole pieces are designed to give the greatest possible damping effect with any given magnetic density in the iron portion of the circuit.

Instead of moving the magnet bodily, adjustment at full load is accomplished by shunting a greater or lesser number of the magnetic lines that would otherwise pass through the disc. Four movable angle pieces attached to the magnet poles provide the necessary means for adjustment. Accuracy at light load is obtained in the usual way; that is, by moving a lever, at the bottom of the meter, to the right or to the left, as may be required, thus shifting a small rectangular conductor situated between the disc and the potential winding. The distortion of the flux obtained by moving

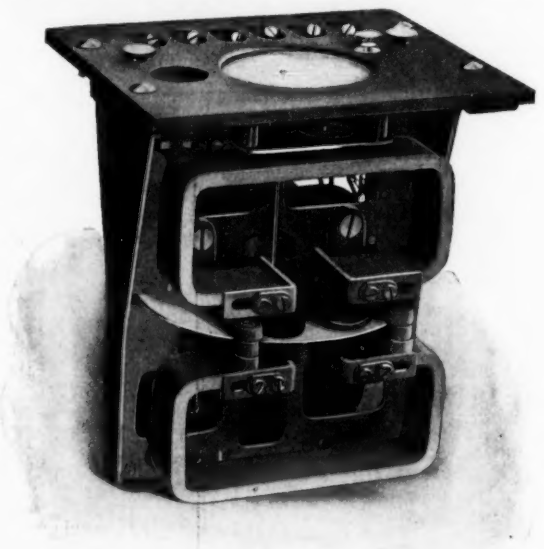


FIG. 3.—METER REMOVED FROM CASE.

the position of this adjusting device alters only the light load accuracy of the meter without affecting the calibration at full load.

As to accuracy, errors for ten per cent changes in voltage or frequency are entirely negligible, as is also the case when measuring inductive loads or operating on circuits of widely different wave forms. The three separate current windings render it possible to obtain the same accuracy on a ten-watt load as on a two-kilowatt load. In other words, the meter possesses the same accuracy throughout a range of 200 to 1.

Extension of Acheson Graphite Works.

The International Acheson Graphite Company, of Niagara Falls, N. Y., with the recent completion of a large extension equipped with the most modern electrical and mechanical appliances and machinery, has doubled the capacity of its plant for creating graphite in the electric furnace, and has closed a contract with the Niagara Falls Power Company for another 1,000 hp of electrical energy in addition to the 1,000 hp previously used. The commercial importance of this artificial graphite may be estimated from the fact that the United States Geological Report for 1904 states that for that year the value of Acheson Graphite produced was $217,790, all the graphite mined in this country amounting to $341,372. New York state, which is considered rich in deposits, according to the official report of 1904 produced natural graphite worth $119,509. Acheson Graphite is largely used in the manufacture of metal protective paints, dry batteries, stove polish, packing and as a lubricant. The electrochemical processes also consume an extensive supply of Acheson Graphite electrodes.

Ball Side-Crank Automatic Engines.

The Ball Engine Company, Erie, Pa., has signalized the occupancy of its new shops by putting out a new line of engines, of which the Corliss type is shown in Fig. 1. As will be seen, the engine is of the side-crank type, and being constructed in sizes from 125 to 1,400 hp, it supplements the well known Ball center-crank engine, which ranges in sizes from 35 to 250 hp. The engine is built in both vertical and horizontal types, simple and compound, with balanced slide valves in the smaller and Corliss valves in the larger sizes. The new type combines the results of the long experience in engine design and building of the Ball Company, and for its manufacture the new shops of the company were specially equipped, thus assuring an engine entirely up-to-date, both in engineering design and in all the refinements of mechanical execution.

Among the reasons for adopting the side-crank type are that it avoids the use of an overhanging wheel, which is particularly objectionable in the case of direct connection to alternators, and it also eliminates a third bearing with the attendant difficulty of maintaining good alignment. In the new type a special and very simple means is provided whereby the alignment may be preserved. Two projections cast on the frame on either side of the main bearing just behind the crank are planed off on a line exactly parallel with the center line of the cylinder. A boss is formed on one side of the crank disc and a gauge is furnished to be attached to this boss; when the gauge is set to the line on one frame projection, by turning the crank half way over and keeping all the end play of the shaft in one direction, the gauge will be brought opposite the other projection. It is obvious that by this means any misalignment will be unerringly indicated. With this arrangement it is extremely easy to test the alignment at any time without recourse to the older method of dismantling the machine and running a line through the cylinder, which method at the best is one requiring great skill to arrive at correct results.

The main bearings (Fig. 2) are of a somewhat unusual construction, whereby the advantages of the two-part box with respect to simplicity of adjustment are combined with those of the four-part bearing with respect to rigidity, and in addition excellent lubrication insured. The bearing is in two parts and the lower box can be conveniently removed by raising the shaft a small amount. The boxes are very solidly locked in position, but yet may be readily adjusted while the engine is in motion. All adjustment is in only one direction and the boxes never have to be taken out to remove shims, since there is practically no wear on the top half of the box, thus permitting the cap to be rigidly bolted down.

The cross-head has babbitted shoes secured in a manner to prevent any possibility of their getting loose or being distorted when secured in place. The adjustment for wear does not shift the shoes endwise and consequently they are always central with the cross-head pin with no tendency to wear faster at one end than the other. The cross-head pin is so arranged than when it wears oval it can be turned through one-fourth of a revolution, thus presenting a new surface for wear, which process can be repeated indefinitely. The connecting rod is of the solid type, the ends being bored and slotted for the reception of the boxes. The boxes at the crank end are of iron, babbit-lined, and those at the cross head end of a special anti-friction bronze having practically the same coefficient as steel and iron, thus preventing the pins being seized through difference of expansion at a temperature more than normal. The adjusting wedges are threaded entirely through for the bolts, and when an adjustment is made the wedge is securely and solidly locked in position.

The crank and pin are machined from one casting of a special mixture of steel and iron having great strength and possessing wearing qualities much better than those of forged steel. This not only secures the best possible wearing surface for the crank-pin, but permits larger shafts and pins than could be otherwise used; in fact, the diameter for the fit on the crank shaft is larger than the diameter of the bearing, which enables the length of fit to be decreased, thus reducing the overhang.

All the principal bearings of the engine are oiled from a system of piping connected to a tank of oil which may be mounted on the top of the engine and arranged to act also as a filter. A pump attached to the crank pin returns the used oil automatically to the tank, this pump being of a special type having the ports for suction and discharge positively opened and shut at the proper time and contain-

ing no valves that can be clogged by waste or other foreign substances. Adjustable sight feeds are provided at each bearing, all of these being piped together and connected to the tank. Where several engines are installed, a large tank may be mounted and a supply pipe run to each engine, thus making a central oiling system for the station.

All of the engines, both of the Corliss and single-valve type, are controlled by a governor of recent invention (Fig. 3), which is claimed to be capable of the best governing that has yet been accomplished, and unlike many governors that can readily be made to fill temporarily the usual manufacturer's guarantee of regulation, it never gives trouble. By far the greater part of governor troubles is caused by pivots under excessive pressure, but in this governor the centrifugal force of the weight is resisted directly by the spring and not transmitted through any bearings. It has a powerful spring which implies a powerful governor not noticeably affected by the ordinary changes in friction of the valves and valve gear. The adjustments are so simple and so certain as not to require an expert; the speed can be changed to a wide range and a fine regulation secured by any one at all competent to make the ordinary adjustments around an engine. The speed is raised or lowered by changing the tension of the spring, the sensitiveness being controlled by moving the link connecting the weight and eccentric in or out along a row of holes provided for that purpose. These two simple adjustments, one controlling the speed and the other the regulation, are positive in their action, very easily made, and once made are permanent. The governor is exceptionally well adapted to engines driving alternators in parallel owing to the absence of excessive friction, and particularly the variable friction in the governor mechanism, which latter is the cause of the interchange of load between the alternators and results in the so-called hunting or unstable operation of the machines.

The parts above described are practically alike in both single-valve and Corliss engines. In the single-valve engines the Sweet balanced valve is employed. While this is an expensive form of valve to make if properly finished, it keeps down the coal bills. Both sides of the valve are finished to true surfaces and to uniform thickness by successive operations of planing, grinding and hand-scraping, the final limit being one five-thousandths of an inch. The valve seat in the cylinder, the pressure plate and the distance strips which hold the pressure plate just far enough from the seat to permit the valve to work freely and yet be steam tight, are all finished with the same high degree of accuracy. The final finishing is done after the parts have been operated in the engine, so that any tendency to warp by heat and pressure may be detected and corrected. Practically the only wear on this valve is downward, which does not affect its tightness in any degree. Being comparatively thin, it can be run in very close adjustment without danger of sticking when starting up, and any wear that may occur is readily taken up. It will lift from its seat and relieve the cylinder from a moderate charge of water. In an extreme case the end of the valve will break out, thus opening the port widely and usually saving the engine, since in this case the only possible way to avoid a wreck is to instantly obtain an opening as large as the ports, and to do this something has to break; naturally there is no comparison between the time and expense of putting in a new valve and the danger, annoyance, delay and expense of repairing an engine which has been wrecked.

In the larger sizes of engines the Corliss type of valve is used, with a gear which retains the essential principle of the Corliss engine, but without its limitations in speed. By the use of the Armstrong non-detaching valve gear (Fig. 4), which is an ideal one for engines of this class, the valves are given a positive movement, prac-

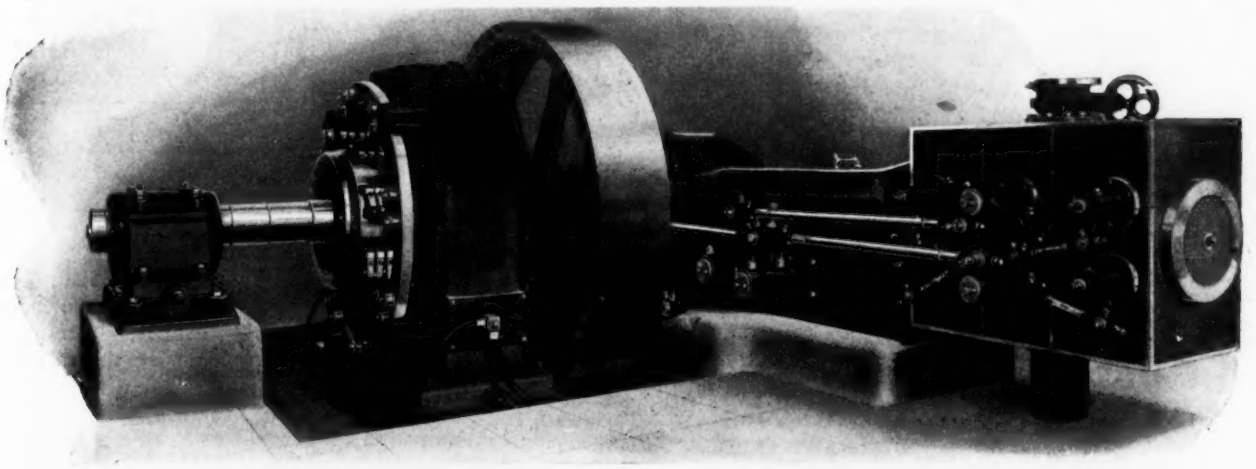


FIG. 1.—HORIZONTAL SIDE-CRANK ENGINE.

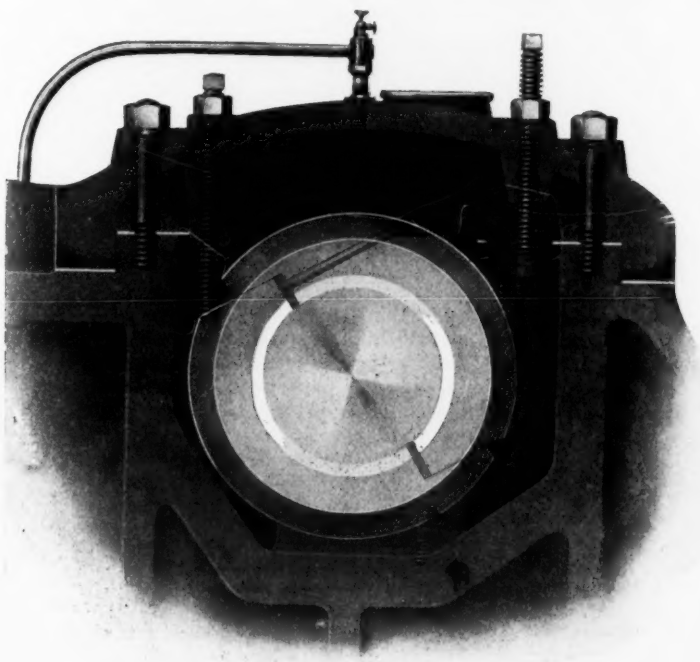


FIG. 2.—BEARING.

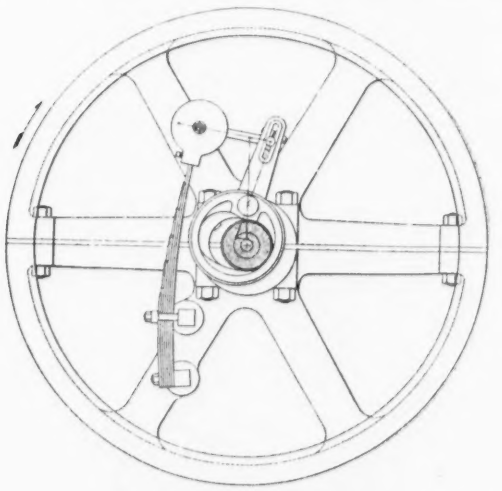


FIG. 3.—GOVERNOR.

tically identical with that accomplished by detaching gear and dashpot. The admission valves remain entirely motionless at least half of the time, start with a smooth and easy motion, and at usual loads have their highest speed at the instants of opening and closing. The

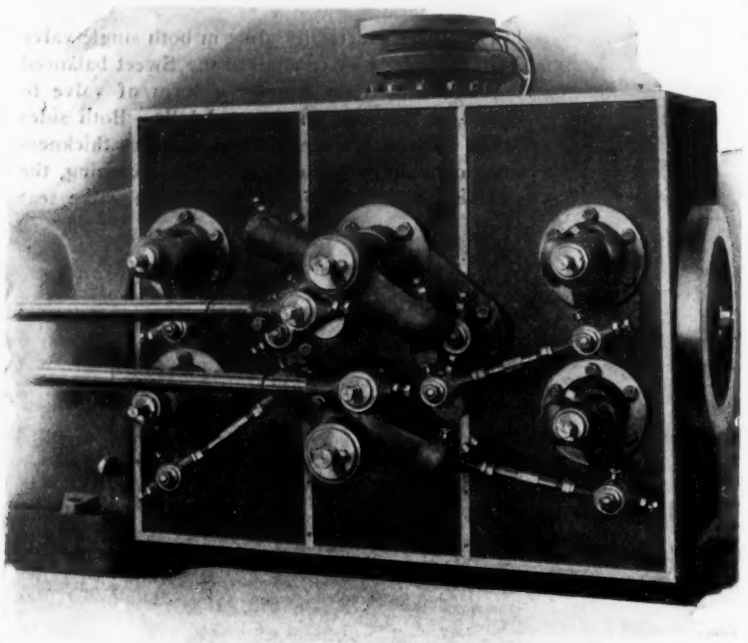


FIG. 4.—VALVES.

motion is diagrammatically represented in Fig. 6, where the eccentric travel is horizontal and the valve travel vertical. The valve opening is in the middle of the valve gear travel when all parts of the gear from the wrist plate to the eccentric are at their highest speed, and consequently have the greatest leverage over the valve at the only time that it moves at all hard. The strain on the gear, from the wrist plate to the eccentric, is by this means greatly reduced, and also comes in the middle of the movement so that there is no reverse stress. The noiselessness of the valve motion does not depend upon closely adjusted bearings, which, in fact, can be very loose in every joint and the engine will still run quietly. This smoothness of action also tends to reduce the wear which takes place in the bearings of the valve gear mechanism.

In cylinders of 20 in. and larger the valves are built in the heads,

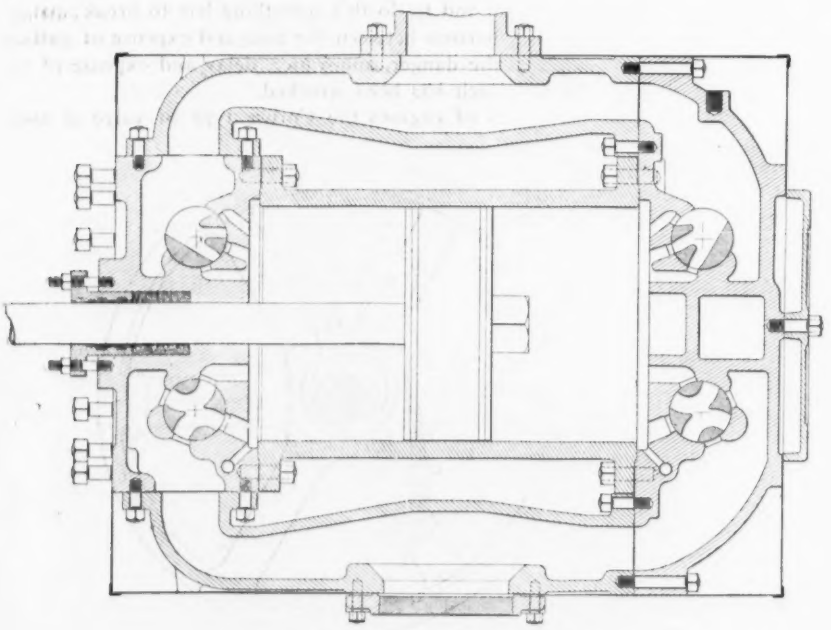


FIG. 5.—SECTIONAL VIEW OF VALVE GEAR.

which permits very large port openings with a minimum clearance space (Fig. 5). Cylinders of less diameter have the valve seats cast integrally with them as in the usual type of Corliss cylinder. As these small cylinders are, however, in the Ball type longer in proportion to the diameter than in the larger ones, the clearance is kept sufficiently low to permit this construction.

The admission valves are triple-ported, permitting a very quick opening and closing without too rapid a movement of the valve, which construction also gives a more uniform pressure on the valve seat while opening and does not tend to wear off the edges of the port and valve as in the case of a single port. The exhaust valves are double-ported and differ slightly from the usual Corliss design in that they close off the ports on both sides of the valve and so

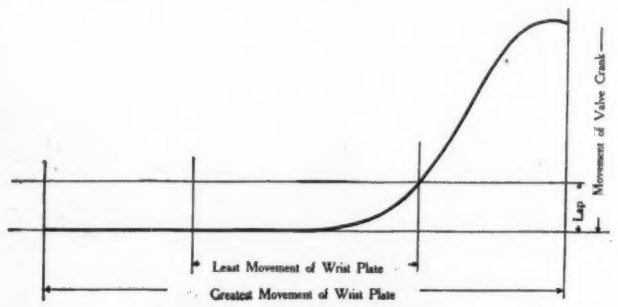


FIG. 6.—MOTION DIAGRAM.

reduce the clearance space, which arrangement also prevents the noise that occurs in Corliss engines, particularly the compound type, when the engine is running lightly loaded and the steam expands below the exhaust pressure, thereby causing the valve to lift. All of the Corliss type of engines are supplied with relief valves built into the cylinders in such a way as not to affect the clearance, and they are of unusually large size to afford all the protection that it is possible to obtain by this means.

The Advantages of Mechanical Draft.

The B. F. Sturtevant Company, of Boston, Mass., in its exhaustive treatise entitled "Mechanical Draft," points out that to a great extent the advantages of this method of draft production are interdependent, and that the possession of one advantage is evidence of the possession of others of similar character. "Thus the very adaptability of mechanical draft is indicative of the fact that it is more flexible than that produced by the chimney, is more readily controlled, and less influenced by climatic changes; while the apparatus for its production is more readily transported and has a higher potential value than a chimney. To a considerable extent these stand out as the conveniences of this method, regardless of their economies. When it is shown that increased efficiency can be secured by a method that is more convenient, the advantage of mechanical draft is established.

"The actual omission of the chimney is sometimes of far greater importance than would at first appear, while the readiness with which the rate of combustion may be increased is doubly appreciated when it is shown that under proper conditions the efficiency of combustion may be increased thereby. The purely economic features are presented most prominently in the ability to utilize low-grade fuels, The economy in the quality of fuel consumed has, in its relation to the use of mechanical draft on shipboard, an advantage which is closely allied to that resulting from the decreased space occupied.

"The economic results which may be secured through the introduction of mechanical stokers and devices for utilizing the waste heat of the gases are rendered most evident under the conditions of mechanical draft production, as are also the great advantage of preventing smoke and the blessings of good ventilation as they are exemplified on shipboard. The facts that the size of a boiler plant required for a given output can be reduced when a fan is substituted for a chimney, that the cost of the mechanical draft plant is usually far less than that of the chimney draft plant, and that its operating expense is likewise less under proper conditions, all point most conclusively to the purely economic advantages of the method which it is the purpose of this book to present."

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The lower temperature of the past week had a decidedly stimulating influence upon retail trade, but it was not cold enough to affect late crops which are maturing very satisfactorily. The utmost confidence prevails in all sections of the country, and excellent reports come in as to large trade in all lines. Manufacturing activity is fully maintained, the leading industries having contracts assuring little idle machinery during the balance of the year, and it is probable that more business will be carried over into 1906 than at the opening of any previous year. The growing disposition to place orders for distant delivery testifies to the well nigh universal faith that no setback will be experienced. Following the great activity in pig-iron buying last week has come a slight lull, but prices, none the less, have been again advanced to 50 cents. Record sales for this period of the year are reported in the past two weeks from Chicago, Philadelphia, Pittsburgh and Birmingham. In finished products the buying by railroads is still a feature; six to nine months' output of rails for next year is already reported booked. In addition, plates for shipbuilding, bars and a multitude of other forms are reported selling actively. Large orders for cars are reported this week. Coke is scarce and selling 35 cents a ton up from the lowest prices of the year. Coal also shows improvement as the season advances, and steam coals are also in better demand. Railway traffic reports suggest that more rolling stock and motive power could be used if obtainable, as is customary at this season, and gross earnings thus far reported for September surpass last year's by 1.1 per cent, which in turn were 6.5 per cent greater than those of 1903. Foreign commerce at New York for the last week showed gains of $3,165,372 in value of merchandise exported and $2,958,392 in imports, as compared with the same week last year. Money is a little firmer, but there is no stringency, and gold imports were checked by higher rates of foreign exchange. Mercantile collections improve as the season advances. Bank exchanges at New York were 31.7 per cent larger than last year, while at other leading cities the increase averaged 18.3 per cent. There is an unprecedented demand at top prices for all kinds of building material, marked freedom from industrial friction, and a market for labor and its products active as rarely before in the country's history. From the cotton belt come reports that no improvement is seen in the plant's condition. Deterioration from rain is reported as the result of heavy rains in the lower Mississippi valley. In the rest of the belt the plant is opening fast—prematurely, in fact, in some sections—and picking is generally active. The agreement is general that varying large shortages from last year's yields are certain, but definite calculation is, of course, still impossible. A large volume of business is being done in machinery, and electrical supplies continue in active demand. The metals are active, and the quotation on the New York Metal Exchange was advanced from 16⅛c. to 16⅜c. for Lake copper. The business failures for the week ending Sept. 28, according to *Bradstreet's*, numbered 185, against 173 the week previous, and 179 in the corresponding week last year.

ELECTRICAL BUSINESS FROM JAPAN.—The General Electric Company has recently received orders from Japan for electrical machinery, as follows: Fusan Electric Company, two 45-kw, belt-driven direct current generators. Ashio Copper Mine, one 50-kw, 500-volt, 50-cycle induction motor; one three-phase 60-kw transformer and two switchboard panels. Nagoya Electric Light Company, 21 two-phase induction motors aggregating 210 horse-power; 40 60-cycle transformers aggregating 215 kw. Tokio Shigai Railway, two 25-hp induction motors. Arakawa Mines, two 65-hp induction motors geared to two Deane single-acting 8½ in. x 12 in. pumps, rated to deliver 650 U. S. gallons of water per minute against 1,010 feet head. Mitsui & Company, Tokio, three 50-kw, three-phase, 3,500-volt Curtis turbine generators; two 25-kw, 450-volt, direct-current tandem-compound marine generating sets; one 125-kw induction motor and 28 other induction motors aggregating 670 horse-power; six 30-kw transformers; nine three-phase transformers aggregating 225 kw, and a switchboard consisting of nine transformer panels.

A NEW INCANDESCENT LAMP COMPANY.—Announcement is made of the formation of the St. Marys Incandescent Lamp Company for the manufacture of incandescent lamps. A factory is now under construction at St. Mary's, Pa., to be completed within two months, which is intended to be the most up-to-date and best equipped incandescent lamp factory in the world. The initial capacity will be 6,000 lamps per day, but additional space will be provided for expansion. It is stated that a competent technical force has been selected, comprising men of long experience who have been prominently identified with the incandescent lamp manufacturing interest. The factory will have the advantage of a supply of natural fuel gas and other means of reducing cost. It is the intention of the company to operate entirely independent of the so-called incandescent lamp combination. The Eureka Electric Lamp Company, of Cleveland, O., organized by Mr. W. M. Rothschild, is merged in the new company, of which Mr. Rothschild is one of the directors. The company is financed by St. Marys, Erie and Cleveland capitalists.

EXPORT TRADE FIGURES.—Complete and classified returns of our foreign trade in August, published by the Government, show that the August export of manufactured goods was the largest by nearly $9,000,000 ever made in August, and the second largest ever made in any month of our history. Only in April of this year has last month's $51,300,000 figure been exceeded. It is a somewhat interesting fact, however, that August's imports of manufactures also established a record. The total was $18,382,000, against $14,309,000 in August last year, and $17,134,000 in April, 1897, when imports broke all previous monthly figures, because of the hurrying-in of articles on which the Dingley tariff's increased duties were to go into effect the following month. In June, 1893, when the movement of foreign manufactures to our shores was at its height, the total was $10,961,000. In the fiscal year 1893, $143,493,000 worth of manufactured goods were imported for consumption; in the fiscal year 1905, the total was $165,886,000.

CALCIUM CARBIDE IN CANADA.—Mr. T. L. Wilson, of Ottawa, Ont., has acquired extensive power privileges on the Saguenay River, Que. With 152 ft. head, over 30,000 hp may be developed at tidewater, with 30 ft. draught for navigation, insuring cheap shipping direct to New York and elsewhere. He estimates at least 250,000 hp available at this point from the 230 ft. head up to the discharge from Lake St. John. Mr. Wilson's property covers three miles of the river, including both banks of the river bed. He has built wharves, and owns a square mile of limestone within a short distance. Mr. Wilson contemplates the use of his electrical power in the production of calcium carbide. Within 20 miles of the shore of the St. Lawrence, and 100 miles below Tadousae, Mr. Wilson says there could be developed a power to the extent of 1,000,000 hp, but it is not now possible to utilize it commercially without a railway on account of requiring to store manufactured product during six months of the year.

GENERAL ELECTRIC IN COPPER.—Press advices from Boston say: "The General Electric Company is now in control of the Bully Hill property in Shasta County, Cal., it having paid $1,500,000 for the property to Captain De Lamar. The property, as acquired, consisted of 213 acres of land developed to a depth of 700 feet. The property was originally opened as a gold mine, but copper ores developed at depth. It is equipped with a smelter which cost $200,000, has two furnaces and a daily capacity of about 300 tons. The Bully Hill has been turning out from 8,000,000 to 10,000,000 pounds of copper per annum, but the General Electric Company will develop the property to permit a considerably larger output. The Bully Hill product, however, will only partially supply the General Electric Company's copper needs, for it consumes not far from 50,000,000 pounds per annum."

BIDS FOR HYDRO-ELECTRIC PLANT.—Bids will be received until Nov. 8 by L. W. Roys, city clerk, Tacoma, Wash., for constructing a hydro-electric generating plant of not less than 5,000 and not more than 10,000 hp delivered on the low tension side of the transformer at the distributing station.

BIDS FOR CABLES.—Bids will be received until Oct. 4 by the Board of Awards, Baltimore, Md., for furnishing for the use of the city of Baltimore underground cables, and for the use of the Electrical Commission special duct pipe. Chas. E. Phelps, Jr., is chief engineer.

TO MANUFACTURE AUTOMOBILES.—The American Locomotive Company, which has works in Schenectady, Providence, and several other cities, is to go extensively into the manufacture of automobiles, automobile trucks, and railway motor cars.

BIDS WANTED FOR LIGHTING FIXTURES.—Bids will be received until Oct. 24 by the Board of Trustees of the Public Library, Columbus, Ohio, for furnishing and installing electric and gas light fixtures. John J. Pugh is secretary.

HOLLAND-AMERICAN CONSTRUCTION COMPANY.—The Westinghouse interests are behind a new company which has been organized for the purpose of building electric railway power and lighting plants, canals and other public works in Europe. The Holland-American Construction Company is the name of the enterprise, and it is incorporated under the laws of the State of New York. The capital is $1,000,000. Holland has been especially chosen as the initial field for operations, largely because of the financial success attending the recently completed street railway which runs from Amsterdam to Haarlem, one of the residential suburbs of that Dutch city. The Amsterdam-Haarlem road was constructed by the London affiliations of the New York engineering and contracting firm of J. G. White & Co., and is owned by the Netherlands Tramways Corporation, which is incorporated under the laws of the State of Connecticut, and the stock of which is largely held by New Yorkers. The original organizers of the Holland-American Construction Company were J. F. Alden, at one time prominently connected with the American Bridge Company; Ralph George Kaelber, H. C. Brewster and C. H. Palmer, of Rochester. The company has now, however, passed into the control of the Westinghouse people. Four out of five of the directors are Westinghouse men. They are Newcomb Carlton, fourth vice-president of the Westinghouse Electric & Manufacturing Company, Limited; George C. Smith and Walter D. Uptegraff, of the Security Investment Company, of Pittsburg of which concern George Westinghouse is president, and Joseph H. Lukach, who is one of the directors and leading spirits in the British Westinghouse Electric & Manufacturing Company, Limited.

RECENT CURTIS TURBINE SALES.—Among recent orders received by the General Electric Company for Curtis turbines are the following: The Jackson Electric Railway, Light & Power Co., Jackson, Miss., has ordered a complete new installation of General Electric apparatus to replace its old plant, which will be abandoned in favor of the new. This apparatus consists of two 500-kw, 220-volt Curtis steam turbine-alternators, two motor-generator sets consisting of a 300-hp induction motor driving a 250-kw, 660-volt, direct-current generator, a 25-kw turbine exciter, a 25-kw induction motor exciter set, with other apparatus, switchboards and appliances. The Queen City E. L. & P. Co., Clarkville, Tenn., has ordered, with other apparatus, a 500-kw, 2,300-volt alternating-current Curtis turbine-generator with a 25-kw exciter. The Consolidated Light & Power Co., Deadwood, S. Dak., has purchased two 500-kw, two-stage, and two 1,500-kw, four-stage, three-phase, 2,300-volt Curtis turbine-alternators, which will be installed in the main steam generating station at Deadwood. The Denver Gas & Electric Co., has ordered a 2,250-kw, three-phase Curtis turbine alternator for its main generating station. The Fairmont & Clarksburg Traction Co., W. Va., has purchased two 500-kw, and one 1,000-kw, 2,300-volt Curtis turbine-alternators. The Public Service Corporation of New Jersey, at Newark, has ordered five 25-kw, 125-volt, non-condensing, direct-current turbine-generators complete with accessories. These will operate with 140 lb. steam pressure, and will be used for exciting purposes.

MORSE CHAIN FACTORY.—The rapidly increasing business of the Morse Chain Company has necessitated the building of a large new plant at Ithaca, N. Y., which will be operated in conjunction with the present factory of the company situated at Trumansburg, N. Y. It is the intention to make this new plant a model one in every way and ample facilities for expansion will be provided. The main building, which will contain the general offices, will be three stories in height and will measure 64x303 ft. over all. The first floor will be used for the machine shop and a floor space of 64x236 ft. has been set apart for this purpose. The other buildings to be provided will be one story in height and their general dimensions are as follows: Foundry, 68x135 ft.; forge shop, 36x86 ft.; pattern shop, 82x28 ft.; power house, 105x45 ft. Steel and concrete have been used throughout in the construction of this plant and everything has been done to provide for an equipment in keeping with the advanced machine shop practice of the times. This is illustrated by the fact that gear cutters, boring mills, lathes and general plant equipment to the amount of $50,000 will be installed, a greater portion of which has already been purchased. The machine shop will be equipped with 10-ton electric traveling cranes, as the light nature of the material under construction does not warrant the installation of very heavy cranes. The foundry will be equipped with electric cranes of 15 tons capacity, having a span of 50 ft.

ROWLAND TELEGRAPHIC APPARATUS.—The Rowland Telegraphic Company, of Baltimore, Md., is shipping a large quantity of apparatus to Germany for the Berlin-Frankfort line, one of the largest circuits in Germany, by the government telegraph authorities. The Rowland company's orders include several installations in America, the most important of which will be a line 1,000 miles long. This line will be equipped with a full octoplex apparatus and will maintain a continuous service about four times as great as has ever been secured in this country over an equal distance upon one telegraph wire. An interesting phase of the introduction of the Rowland system in America is its use upon private leased lines. The company has contracted to install a line of this kind between New York and Schenectady for the General Electric Company. The company will exhibit a quadruplex apparatus at the Milan Exposition of 1906, probably under the auspices of the Italian Government. The project of an entire change in the operation of the Italian telegraphs, based upon the introduction of the Rowland system, is now actively before the Italian Parliament. The Rowland engineers accompanying the installation going to Germany are Mr. Walter A. Houghtaling, formerly of the Postal Telegraph Cable Company, and Mr. L. Virgil Lewis. The chief engineer of the company, under whose direction the apparatus has been perfected, is Dr. Louis M. Potts, a graduate of Johns Hopkins University.

WILLIAM ROCHE DRY BATTERY COMPANY.—The business which has been conducted since the year 1897 by Mr. William Roche, at No. 52 and 54 Park Place, New York City, has been incorporated and is now owned by William Roche Dry Battery Company, a corporation organized under the laws of the State of New York, with a full-paid capital of $25,000. Mr. William Roche is the president of the new corporation, and has associated with him Messrs. C. Laton Ford (formerly first vice-president Celadon Roofing Tile Company, New York City), Ernest A. Lowe (president of the Lowe Electric Company), and William C. Hubbard, for a number of years with Westinghouse Electric & Manufacturing Company. The assets of the business have been taken over by the new corporation and all its liabilities have been assumed and will be paid by the new company. Mr. Lowe is vice-president, Mr. Ford, treasurer, and Mr. Hubbard, secretary. The Roche dry batteries and spark coils have won a most enviable reputation and are known the world over. They have been greatly favored by the United States Government, and are specified in many army and navy contracts for exacting work.

SWITCHBOARD EQUIPMENT COMPANY.—The Switchboard Equipment Co., of Pittsburgh, is moving its entire outfit to Bethlehem, Pa., and will maintain only a branch office in Pittsburgh, under the care of Mr. H. O. Smith, at 504 Lewis Building. The present plant has been found entirely inadequate, and Mr. D. R. Smith, the president, says that at Bethlehem they have not only a better location, but secure less expensive labor and proximity to the metropolitan market. The new shop is particularly adapted to their needs, being equipped as completely and efficiently as modern practice permits. It is several times the capacity of the old, and with the beginning of this month, they will be able to turn out circuit-breakers, etc., in larger quantities and make deliveries in the shortest possible time.

ARIZONA PLANT.—Plans and specifications are on file at the office of *The Engineering Record*, 114 Liberty St., New York, N. Y., for furnishing complete f. o. b. bidders works, one or more alternating-current, 900-kw, 25-cycle generators, one or more 100-kw, direct-current generators, for exciters, and one switchboard, for use in the Roosevelt power house, Roosevelt, Ariz., bids for which will be received until Nov. 1 at the office of O. H. Ensign, Los Angeles, Cal. Specifications are also on file for one or more 1,260-hp water wheels and one or more 140-hp water wheels with gate valves, pipe connections and governors for the Roosevelt power house, bids to be opened at the same place on Nov. 2.

THE ALBERGER CONDENSER COMPANY, 95 Liberty Street, New York, and 205 La Salle Street, Chicago, announces that it has recently acquired the entire Wainwright business, and will hereafter manufacture and sell the well known Wainwright feed water heaters and expansion joints. These specialties have lately been manufactured by the Taunton Locomotive Manufacturing Company, Taunton, Mass., which is now going out of business. Mr. William R. Billings, formerly treasurer and general manager of that company, has become connected with the Alberger Condenser Company and will be in charge of the Wainwright business under its new ownership.

GENERAL ELECTRIC RAILWAY MOTORS.—The latest 40-hp railway motor of the General Electric Company, known as the GE-80, is prominent and extensively known, as indicated by several recent orders from foreign countries, including 42 two-motor GE-54 equipments and six two-motor, GE-70 equipments for the Lima City tramways, Peru; 142 two-motor, GE-58 equipments with B-13 controllers and electric brakes for Milan Edison Company, Italy, which road uses General Electric equipments exclusively; 12 GE-70 motors for the Cape Electric tramway, South Africa, and five two-motor, GE-80 equipments for the Victoria Railway, Melbourne, Australia.

CONDUIT IN GENEVA.—The Board of Public Works, Geneva, N. Y., has authorized the superintendent to call for bids for the construction of 18,000 ft. of conduit.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was heavy in tone in view of the narrow money market conditions, although aggressive bearish activity was lacking. The advance in call-loan rates to 7 per cent acted as a check upon a further upward movement. Early in the week manipulative interests took hold of Brooklyn Rapid Transit and advanced it a little, with some effect on the other traction stocks. The standard railroad stocks were all somewhat heavy, irregular recoveries being succeeded by renewed declines. The industrials were not especially prominent, but the United States Steel stocks had support at the concessions, although they were affected by the general tendencies of the market. The electric and traction stocks were firm, notwithstanding the irregularity of other shares. Allis-Chalmers common and preferred both made net gains, the former ¾-point and the latter 2 points, the closing quotations being 18½ and 60, respectively. The sales of these shares were unusually large. General Electric made a gain of 2 points, closing at 181½, and Westinghouse advanced 2½, the last price being 170, ex-div. Metropolitan Street Railway was the exception and lost 2½ points, closing at 125⅞. Interborough Rapid Transit closed at 215¾, a net gain of 2¼, and Brooklyn Rapid Transit, of which 208,700 shares were sold, closed at 72⅜, an increase of 1⅞. Western Union remains steady at 93¼. Mackay common closed at 44¾, a net gain of 2 points. Trading on the curb was quiet, for the most part, during the week, with a sensational drop of 30 points in Chicago Subway and a rise of some 10 points in Standard Oil the only features. Both of these incidents excited a good deal of discussion. The collapse in Chicago Subway differed from those in other stocks which have occurred during the last few years, in that it did not imply any weakness in the company's financial position. From all indications the company is flourishing, though making less progress with its excavations than was promised some time ago. Chicago Subway closed at 56. The closing quotations of Oct. 3 are given in the following list:

NEW YORK

	Sept. 26	Oct.		Sept. 26	Oct. 4
Allis-Chalmers Co.	18⅝	18	General Electric.	182	182
Allis-Chalmers Co. pfd.	59¾	60¼	Hudson River Tel.	..	..
American Dist. Tel.	30	32	Interborough Rap. Tran.	212	213
American Tel. & Cable.	92	92	Mackay Cos.	43	46⅛
American Tel. & Tel.	138	138	Mackay Cos. pfd.	74¼	74
Brooklyn Rapid Transit.	72	72⅜	Marconi Tel	..	..
Electric Boat	30	30	Metropolitan St. Ry.	125⅞	126⅜
Electric Boat pfd.	70	70	N. Y & N. J. Tel.	..	..
Electric Lead Reduction.	..	..	Western Union Tel.	93¼	93¼
Electric Vehicle.	17	17	Westinghouse com.	169¼	168¼
Electric Vehicle pfd.	22	22	Westinghouse pfd.	..	..

BOSTON

	Sept. 26	Oct.		Sept. 26	Oct. 4
American Tel. & Tel.	140⅛	139⅛	Mass. Elec. Ry. pfd.	56	58⅛
Cumberland Telephone.	119⅛	121	Mexican Telephone.	1¾	1⅝
Edison Elec. Illum.	247½	250	New England Telephone.	136	137
General Electric.	181	181	Western Tel. & Tel.	16	14
Mass. Elec. Ry.	14	13	Western Tel. & Tel. pfd.	97	95

PHILADELPHIA

	Sept. 28	Oct. 4		Sept. 26	Oct. 4
American Railways.	52⅛	62⅛	Phila. Electric.	8⅞	9
Elec. Co. of America.	11	11⅜	Phila. Rapid Trans.	27⅛	28
Elec. Storage Battery.	85	84	Phila. Traction.	100¾	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Sept. 26	Oct. 4		Sept. 26	Oct.
Chicago City Ry.	195	200	National Carbon.	60	83
Chicago Edison.	..	..	National Carbon pfd.	114⅛	..
Chicago Subway.	..	..	Union Traction.	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
Metropolitan Elev. com.	25¼	25⅛			

* Asked.

CONSOLIDATION IN SAN FRANCISCO.—The plan for the consolidation of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation is being carried out according to programme. On Sept. 20 55,000 shares out of the 158,484 shares outstanding of the former company and 63,000 shares of the 150,000 shares outstanding of the latter company were placed in escrow with the Union Trust Company. The owners of the California Gas & Electric Corporation together with N. W. Halsey & Co., the New York bankers, are to purchase the stock of the other company. It is expected that the required amount of stock will be deposited before Nov. 15, when the deal is to be closed. Articles of incorporation of the new company, which is to be the holding corporation for the two companies that are being merged, are being prepared. Its preferred stock will go to Martin, De Sabla and their associates for their putting 80,000 shares of the California Gas & Electric Corporation shares in escrow in the Union Trust. Its common stock will go to N. W. Halsey & Co. for supplying about $4,000,000 in cash as part payment to the holders of San Francisco Gas & Electric stocks. The bonds of the new company to the extent of $10,000,000 also go to the San Francisco Gas & Electric stockholders in part payment. The stock being placed in escrow with the Union Trust Company, will be held as security for these 5 per cent bonds until they are all paid off. By means of a sinking fund they will be paid off at the rate of $250,000 a year. The Mutual Electric Light Company has not been absorbed by the projectors of the lighting merger.

INDIANA TROLLEYS.—Chandler Bros. & Company have compiled a pamphlet showing the properties, capitalization and earnings of the twenty-two principal electric railways in Indiana. It is a remarkable exhibition of development. The capitalization of the twenty-two principal companies in the State shows a total authorized of $128,350,000 and a total issued of $103,947,500. This is divided into stock outstanding $54,217,500 and bonds issued $49,730,000. The interest at 5 per cent on the bonds amounts to $2,486,500. The net earnings last year were $3,025,000. The twenty-two systems included in the booklet have a total mileage of 1,207 in operation. This will be increased to about 1,500 miles by the close of the current year. The gross earnings of all roads reporting earnings last year were $6,839,012 and operating expenses $3,813,171, leaving net earnings of $3,025,841.

WESTINGHOUSE BRAKE.—The total income of the Westinghouse Air Brake Company for the year ended July 31 was $7,958,568, an increase of $2,018,515 over the income of 1903-4. The net earnings increased $594,598. The income account, showing comparisons with last year, is:

	1905.	1904.
Total income	$7,958,568	$5,939,953
Expenses	†4,999,789	3,575,772
Net	$2,958,779	$2,364,181
Charged off and special depreciation fund	.....	26,022
Surplus	$2,958,779	$2,338,159
Dividends	2,198,215	2,417,899
Surplus	$760,564	*$79,740

†Includes depreciation. *Deficit.

DIVIDENDS.—The Electric Storage Battery Co. has declared a dividend of 1¼ per cent on both the common and preferred stocks, payable October 2. E. W. Bliss Co. have declared the regular quarterly dividends of 2½ per cent on the common stock and 2 per cent on the preferred stock, both payable Oct. 2. The Manchester Traction, Light & Power Co. has declared a regular quarterly dividend of 1½ per cent, payable Oct. 16. The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 14. The directors of Cincinnati, Newport & Covington Light & Traction Company have declared the regular quarterly dividend of 1⅛ per cent on the preferred stock, payable Oct. 16. The directors of Standard Underground Cable Company have declared a quarterly dividend of 3 per cent, payable October 10.

U. S. TELEPHONE COMPANY.—Advices from St. Louis say that arrangements for the financing of the United States Telephone Co., recently incorporated at Albany with $50,000,000 capital, are going forward in New York, Pittsburg and St. Louis. The object of the new combination is to unite the long-distance trunk lines of the independents. St. Louisans who are interested say that within 18 months there will be an independent long-distance system from New York to St. Louis. Several New York banking firms are said to be concerned in the negotiations which are being conducted in the cities named.

CHICAGO ELECTRIC TRACTION.—By the sale of the Chicago Electric Traction Company to Indiana capitalists the Interurban Electric lines of the State will secure an entrance to Chicago, which they have been seeking for years, and by the construction of a line from Harvey to Kanakee their object will be accomplished. Jules S. Bache, of New York, chairman of the reorganization committee, announces that the syndicate gave the equivalent of $650,000 cash and $200,000 in stock of the interurban company for the property. The company's entire capital stock is not to exceed $2,000,000.

CONSOLIDATION IN KNOXVILLE.—The Knoxville Traction Company and the Knoxville Electric Light & Power Company have been merged into the Knoxville Railways & Light Company. A mortgage for $3,000,000 in favor of the Standard Trust Company, of New York City, has been recorded, looking to the complete refinancing of the properties. Ford, Bacon & Davis, New York engineers, will have charge of both light and railway construction.

ELECTRICAL EARNINGS.—The Manila Electric Railway & Light Company reports $76,900 gross for August, and $37,190 expenses. The Milwaukee Electric Railway & Light Company reports $277,015 gross for August and $152,852 total net. For eight months the total net income is $1,072,348, with $609,001 charges, leaving a surplus of $463,347, a gain of $32,179 over 1904.

INCREASED BULLOCK CAPITAL.—It is announced from Cincinnati that the capital of the Bullock Electric Company (Allis-Chalmers Company lessee) will be increased from $500,000 to $3,000,000. Of this increase, $1,500,000 will be 6 per cent cumulative preferred and $1,500,000 common. The purpose is to provide funds for extensive additions.

GAS AND ELECTRIC BONDS.—N. W. Halsey & Co. and Howard, Simmons & Co., have purchased an issue of $1,400,000 Western United Gas & Electric Company bonds.

General News of the Week

The Telephone.

BIRMINGHAM, ALA.—It is proposed by the City Council to have all the telephone and telegraph wires placed in underground conduits in this city, and an ordinance is now being drawn.

BIRMINGHAM, ALA.—The Independent Long-Distance Telephone Company's line between Decatur and Birmingham and between Bowling Green, Ky., and Decatur is almost completed. When finished connections will be made at Bowling Green with independent lines of the north and east, which will give Alabama independents connection with nine other states. Traffic arrangements are made with the independent exchanges in cities which the lines touch, including Birmingham, and there is a close business agreement between the long-distance company and the independent exchanges. The line will be extended to Memphis, Atlanta and Mobile.

LITTLE ROCK, ARK.—The Boonesboro and Stillwell Telephone Company has changed its name to the Cane Hill and Stilwell Telephone Company. The capital stock was increased to $10,000.

HANFORD, CAL.—P. H. Kerr Higgins, of Los Angeles, has petitioned for a telephone franchise here.

SAN FRANCISCO, CAL.—E. B. Jones, of Salt Lake City, who financed for $5,000,000 the Independent Telephone Company, which operates in Salt Lake City and surrounding towns, recently spent several days in San Francisco, looking over the telephone situation. Conferences were held with local business men regarding the support that might be expected if Mr. Jones and his associates entered the local field. The Home Telephone Company's application for a franchise has not yet been acted upon by the Board of Supervisors, and it is probable that there will be other bidders when the franchise is put up for sale.

COLORADO SPRINGS, COL.—The Home Telephone Company, with a capital of $50,000, has been incorporated by R. M. Handy and J. K. Vanatta.

BOISE, IDA.—The Bell Telephone Company has been granted permission to lay underground wires in this city.

WEISER, IDA.—The Independent Telephone Company has asked the City Council for a franchise to operate in this city.

POCATELLO, IDA.—The Rocky Mountain Bell Telephone Company is installing a new exchange in this city. Important improvements in its local system will also be made.

POCATELLO, IDA.—Articles of incorporation of the Yellowstone Park Railroad have been recently filed. A telephone system is to be operated in connection with the proposed road.

LEWISTON, IDA.—The Lewiston-Clarkson Home Telephone Company, Ltd., with a capital of $50,000 is pushing its business. Mr. J. E. McGillivray, manager, says, "We have organized an independent telephone company here with a considerably larger list of subscribers than that of the Pacific States Company. In a short time we shall begin the construction of a common battery multiple plant, with a capacity of 1,000 telephones, for which 700 contracts have been obtained to date, as against 500 in operation on the Bell plant. We are now in the market for all that goes to make up a modern plant. Part of the system will be underground construction.

FORT DODGE, IA.—The Badger Telephone Company has been formed. Capital, $10,000. Incorporated by H. E. Myhre, P. J. Folvag and others.

HAVELOCK, IA.—The Havelock Mutual Telephone Company has been formed with a capital of $28,000. George A. Speer is president; W. E. Pirie, secretary.

LINCOLN, ILL.—The Central Illinois Telephone & Telegraph Company has filed its acceptance of the new franchise ordinance.

PEORIA, ILL.—The Citizens' Telephone Company is installing another switchboard. This improvement will give a capacity for twelve hundred telephones.

NORTH VERNON, IND.—The Bell Telephone Company has established a new exchange in this city.

FENTON, MICH.—The Union Telephone Company has purchased control of the Fenton Mutual Telephone Company. A new system is to be installed and day and night service given.

SAULT STE. MARIE, MICH.—It is said that the Michigan State Telephone Company is about to buy the Pickford line, owned by F. S. Taylor, and that copper wire will be strung and the line extended to DeTour.

MUSKEGON, MICH.—The Michigan State Telephone Company is extending its lines from Muskegon to Pentwater. From Pentwater a submarine cable will be laid to connect with the line entering Ludington. A new switchboard has been installed at Muskegon.

FOLEY, MINN.—The Northwestern Telephone Exchange Company is contemplating the installation of an exchange in this place.

ALBERT LEA, MINN.—The Northwestern Telephone Exchange Company has purchased the local telephone exchange and will make improvements to cost $20,000.

ST. CHARLES, MINN.—The Northwestern Telephone Exchange Company, a franchise to which was recently refused by the City Council of St. Charles, is beginning an action in the Federal court to compel officials of St. Charles to show cause why it should not be granted a franchise.

RED LODGE, MONT.—It is stated here that the Bell Telephone Company will shortly purchase the system of the Montana-Wyoming Company.

BUTTE, MONT.—The Bell Telephone Company has decided to place all its wires in this city underground, and work in that direction will be commenced at once.

GREAT FALLS, MONT.—All the telephones of the Montana Central along the Neihart branch, and the Shelby line, have been removed and a telegraph system substituted.

ST. LOUIS, MO.—John L. Dunlop and J. M. Fetter, of Louisville, Ky., have been selected to do the underwriting in Kentucky for the United States Independent Telephone Company, and came to this city to make formal arrangements in the mattter. The United States Company is a merger of a number of large telephone companies. It is capitalized at $50,000,000. The apportioning of the underwriting is in the hands of Breckinridge Jones, of the Mississippi Valley Trust Company, of St. Louis.

TRENTON, N. J.—A committee of the directors of the Interstate Telephone Company of New Jersey, headed by William H. Hancock, of Trenton, N. J., has been appointed to look after the reorganization of the company.

PERTH AMBOY, N. J.—After accepting a franchise for twenty-one years and agreeing to pay to the city a perceptage of its gross receipts, the Hudson & Middlesex Telephone Company has startled Perth Amboy by its offer to build and maintain a private telephone line from the City Hall to the Runyon water station, eight miles away, for $200 a year. Nearly a mile of the line will be a cable under the Raritan River. The New York & New Jersey Company asked $275 a year for the cable under the river, and wanted the city to build its own line from the cable end to Runyon. The Hudson & Middlesex offer was accepted and a contract will be made for 20 years.

ELLICOTTSVILLE, N. Y.—The Home Telephone Company has been formed, with a capital of $10,000, by Thaddeus S. Lane, of Jamestown, N. Y., and W. B. Page.

JAMAICA, L. I., N. Y.—The New York & New Jersey Telephone Company is erecting a new exchange building in this place. The cost of the structure is placed at $80,000.

CHARLOTTE, N. C.—The Bell Telephone Company will extend its lines out 12 miles from Charlotte to Beattie's Ford.

LEXINGTON, N. C.—The Piedmont Telephone Company has been incorporated at Lexington by Walter G. Finch and others, to build lines in Randolph and Davidson counties in North Carolina.

CHARLOTTE, N. C.—At the coming session of the South Carolina Legislature a bill will be introduced to require the Southern Bell Telephone Company to connect with all the small independent lines in the State. The railroad commission is now investigating the telephone situation to find the cost of connecting lines and the rates that would be equitable for long-distance connections.

SPRINGFIELD, OHIO.—The Select Telephone Company has been organized. Capital, $60,000. Incorporated by F. W. Cangoling and Edgar C. Hampton.

CINCINNATI, OHIO.—The Farmers & Merchants' Mutual Telephone Company has been organized, with a capital of $10,000, by G. W. McKeegan and others.

TOLEDO, OHIO.—It is stated that the party of Toledo capitalists who some months ago promoted the Cuyahoga telephone deal, are negotiating for the control of the Independent Co-Operative Telephone Company, of Detroit, and that the property will likely pass into their hands.

WAPAKONETA, OHIO.—The committee representing the bondholders who purchased the property of the Commercial Telephone Company, operating in Central and Southern Texas, sold under receivership proceedings, have reorganized the company, increased the capital stock to $500,000 and mapped out work for the projection and equipment of the system which now extends over 1,000 miles.

HURON, S. D.—D. B. Jeffries is seeking a franchise for a local telephone exchange.

HOUSTON, TEX.—The Southwestern Telegraph and Telephone Company is laying underground conduits along Preston Avenue from Hamilton to Caroline. Last year the company began laying the conduits and proposes to put down a certain percentage every year until the entire system is beneath the ground.

PRICE, UTAH.—The Eastern Utah Telephone Company has filed articles of incorporation. The capitalization is $50,000.

VANCOUVER, WASH.—Charles E. Sumner, of the Home Telephone Company, has asked for a franchise for the automatic telephone system.

SEATTLE, WASH.—The Independent Telephone Company, of Seattle, has made arrangements to branch out into Oregon and British Columbia. It is reported that bonds to the amount of $1,000,000 are being floated in New York for the improvement of the system. Later it is planned to invade eastern Washington, working from Spokane as a base and absorbing the smaller independent lines.

BALDWIN, WIS.—The Bush River-Eau Galle Telephone Company has been formed with a capital of $3,500, by Lewis Crogen and Edward Christensen.

SHEBOYGAN, WIS.—The City Council has passed an ordinance requiring that electric light and telephone wires be placed underground. Bids for terra-cotta conduits will be advertised for at once.

Electric Light and Power.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of Los Angeles, is preparing to develop electric power in Yavapai County, Ariz. The initial installation will consist of a 1,200-hp. hydro-electric plant, which it is expected will be increased to 6,000 horse-power eventually.

SAN FRANCISCO, CAL.—The Nevada Power Mining & Milling Company's electric power plant on Bishop Creek, Inyo County, Cal., has gone into commission after making a good record for construction. One of the two 750-kw, 3-phase National Electric generators of the initial installation is in successful operation, supplying lights in Tonopah and Goldfield, Nev. The second generator is being installed. A Pelton water wheel, operated under a head of 1,064 ft., is direct connected to each generator. The transmission line extends 85 miles to the junction at Alkali Springs, where it branches, the distance thence to Tonopah being 18 miles, and to Goldfield, 10 miles. An elevation of over 10,000 ft. is reached in crossing the White Mountains. An additional Bullock generator, of 1,500 kilowatts capacity, will be delivered by the Allis-Chalmers Company about December 1 and connected to a Pelton water wheel. The home office of the company is in Denver, Col.

YREKA, CAL.—Since the consolidation of the Siskiyou and Yreka electric light and power plants, many changes have been made, with more contemplated for greater capacity. At present the old Yreka plant at Shasta River, will be used for lighting purposes in supplying Yreka, Fort Jones, Greenview, Etna, etc., while the Siskiyou plant at Fall Creek, Klamath River, will supply all the power used and the lights at a number of places in Shasta Valley, and be taxed with 400 horse-power for the operation of the Montague box factory and the Yreka Creek dredger. A couple of large transformers have been sent over to Humbug, where about 40 horse-power will be used for the new Mono quartz mill. The Siskiyou Company is also putting in a large new dynamo at Fall Creek, which will increase the capacity of that plant from 700 to 2,000 horse-power, and there is 400 horse-power at the Shasta River plant, which makes a capacity of 2,400 horse-power. When the new dynamo is installed the two plants will be joined for supplying both systems, with expectation of extending wires to all other sections of the county, where needed.

DENVER, COL.—It is stated that improvements costing nearly $1,000,000 are to be made by the Denver Gas & Electric Company to its plant during the coming year. Next spring in the plant at Sixth and Lawrence streets a new Curtis 3,000-kw generating turbine is to be installed. Later on in the year a similar turbine is to be installed in this plant. New machinery costing about $150,000 to replace worn-out apparatus is to be purchased by the company. The building is to be enlarged at a cost of about $45,000. Four 500-hp boilers are to be installed.

COCHRAN, GA.—Bids for the purchase of $17,000 electric light and water bonds are wanted at once. Address Dr. T. D. Walker, chairman of the bond commissioners.

MONTICELLO, GA.—The town of Monticello has bought the electric light plant, the property of B. Jordan, and will operate it in connection with the waterworks system, using electric power for pumping the water. The two plants will be operated together.

LAWRENCEVILLE, GA.—J. W. Chapman, of Lawrenceville, has secured an option on a water-power near Brevard, N. C., and proposes to develop the same, and will build an electric light plant to supply the town of Brevard, and the Transylvania Railroad.

SAVANNAH, GA.—The Savannah Lighting Company has formally accepted the lighting franchise granted it by special ordinance. A representative of the American Conduit Company is expected here to make estimates on the underground work, although there is a report that the conduits of the Georgia Telephone Company may be used.

LEWISTON, IDAHO.—The Clearwater Irrigation, Land & Boom Company has been incorporated, with a capital of $150,000, by H. L. Pittock and F. W. Leadbetter, of Portland, Ore., and L. A. Porter, of Lewiston.

FREEBURG, ILL.—Plans and specifications have been completed by Owen Ford, of St. Louis, Mo., for the proposed municipal electric light and power plant, to cost about $9,000. Charles Keessler is village clerk.

BREESE, ILL.—The Breese Water & Light Company is preparing to install a central lighting plant, and will receive bids on the entire equipment until October 9. William H. Bryan, Lincoln Trust Building, St. Louis, Mo., is the consulting engineer in charge of the work.

CHICAGO, ILL.—Bids will be received until October 23 by the county commissioners for the old electric light plant at the county hospital, consisting of two Ideal engines, 125 horse power each; four National Electric direct-current dynamos, of 35 kilowatts each. William McLaren is superintendent of public service.

CRAWFORDSVILLE, IND.—J. F. Davies, of Toledo, Ohio, has secured the contract for repairing the city electric light plant at $7,433.

VALPARAISO, IND.—The Valparaiso Lighting Company has been incorporated, with a capital of $150,000. The directors are C. H. Geist, C. B. Kelsey and Edw. Clifford.

SHELBYVILLE, IND.—The Shelbyville Water and Electric Light Company's plant has been purchased at receiver's sale by C. F. Street, of New York, the consideration being $36,000. Mr. Street will at once improve the property, retaining Mr. F. M. Nichols as superintendent.

WYNNEWOOD, IND. TER.—An election will probably be held the latter part of October to vote on issuing bonds for the construction of an electric light plant and water works, to cost $40,000.

MARSHALLTOWN, IA.—The General Electric Company has secured the contract for a new dynamo for the city lighting plant at $3,100.

COVINGTON, KY.—The National Construction Supply Company, of St. Louis, Mo., has submitted to the light committee of the General Council a proposition to install an electric light plant, with duplicate machinery of sufficient capacity to supply 400 arc lights of 2,000 candle power and 2,000 incandescent lights, for $75,000.

PORTLAND, ME.—The International Paper Company has brought a bill in equity in the United States Circuit Court here against the Bodwell Water Power Company of Old Town, asking the court to restrain the latter company from erecting and maintaining dams on the Penobscot River and the Stillwater branch.

ELK RAPIDS, MICH.—Arthur McMillan, of Toledo, has been granted a franchise for a commercial lighting plant in Elk Rapids. The village is to have not less than 25 arc lights at $75 per light, and above 25 lights the charge is to be $70 per light, on a moonlight and two o'clock schedule.

MIDLAND, MD.—The Consolidated Coal Company, it is stated, will erect a plant at Ocean Mine No. 1, with power enough to supply light to the town of Midland and surrounding places.

EDINA, MO.—The Edina Light Company has been incorporated, with a capital of $10,000, by Fred J. Wilson, Jane D. Wilson and Paul K. Gibbons.

WARSAW, MO.—At a special election held September 25 the proposition to issue bonds to the amount of $6,000 to build and maintain a municipal electric-light plant was carried. The present plant has proved inadequate.

MOREHEAD CITY, N. C.—Cincinnati capitalists have closed a contract with J. W. Riley, of Morehead City, to erect an electric light plant in this city, to cost about $15,000.

FAYETTEVILLE, N. C.—The Public Works Commission of Fayetteville, N. C., has issued specifications for a municipal lighting plant of 140-200-k.w. capacity. Proposals will be received to October 10.

SALISBURY, N. C.—It has been found that the water power at Whitney, near Salisbury, with a dam proposed to develop 25,000 horse-power, will, on account of the larger size of the basin, be capable of developing 50,000 horse-power. It is expected that the company, in which Mr. E. B. C. Hambley, of the Whitney Reduction Company is interested, will have 50,000 electrical horse-power on the market in two years. The contracts have been let for the dynamos, water-wheels, etc., for six units of 8,000 horse-power each. It is said that when the first 50,000 horse-power is developed, there will be 50,000 horse-power additional awaiting attention and that this will be developed, making a total capacity of 100,000 horse-power at the company's plant on the Yadkin River.

PORT CLINTON, OHIO.—The Port Clinton Electric Light & Power Company will add a district heating system to its plant.

LOVELAND, OHIO.—The Loveland Citizens' Electric Company has decided to issue $50,000 bonds, to be used for the extension of the plant.

LOUDONVILLE, OHIO.—Th electric light plant at this place was almost totally destroyed by fire Sept. 17. The city will be in darkness for weeks and the water supply will be cut off, as the plant furnished the power for pumping the water into the reservoir. The plant was owned and operated by the city and was valued at $10,000. The loss is partially covered by insurance.

HUNTINGDON, PA.—The Juniata Water & Power Company, recently incorporated, has purchased a site for a hydro-electric power plant in Warrior Ridge Gap. Construction will be started as soon as plans can be prepared. The proposed plant will cost about $1,000,000. S. L. Brumbaugh, of Philadelphia, is the manager.

WYOMING, R. I.—It is reported that an electric plant is to be built at Wyoming with a view to supplying electricity for the different business places in the two villages and possibly for street lighting.

ABERDEEN, S. D.—A vote will soon be taken in this place on the issuing of $35,000 bonds to establish a municipal lighting plant or to grant a franchise to put in such a plant.

CHATTANOOGA, TENN.—The Chattanooga & Tennessee River Power Company has been reorganized, with C. E. James, of Chattanooga, president; J. C. Guild, of Chattanooga, chief engineer, and John Bogart, of New York, N. Y., as consulting engineer.

HUMBLE, TEX.—The electric light and power plant was destroyed by fire recently.

WICHITA FALLS, TEX.—The Wichita Falls Water-Works Company has changed its name to the Wichita Falls Water & Light Company, and increased its capital from $50,000 to $75,000.

RICHMOND, VA.—As to the proposed municipal electric light and power plant, the city attorney has been requested to prepare an ordinance for the issue of $500,000 light plant bonds. The plant proposed will have a capacity of 2,000 horse power.

OLYMPIA, WASH.—The Pend O'Reille Electric Company, of Spokane, has filed articles of incorporation, with $50,000 capital stock, by J. L. Drumheller, W. G. Malloy, Joseph Scott and D. M. Drumheller.

OMRO, WIS.—The village will change the electric street lighting from arcs to incandescent.

LITTLE CHUTE, WIS.—The Village Board has granted a franchise to furnish electric lights to the Kaukauna Electric Company.

FORT FRANCES, ONT.—The Council is considering the installing of an electric light plant.

OSHAWA, ONT.—The Oshawa Light & Power Company has been incorporated, with a capital of $100,000.

TORONTO, ONT.—The city received authority at the last session of the Legislature to expend $40,000 for a new electric light plant on the Island, and the matter is now being undertaken.

The Electric Railway.

COLTON, CAL.—The Chamber of Commerce is considering the question of constructing an electric railway to Colton, Seth Hartley having asked for the franchise. The plan is to build a line from the west end of the county from Upland.

WASHINGTON, D. C.—The receiver for the City & Suburban Railway Company has been discharged and the long litigation over its property has ended.

EAST ST. LOUIS, ILL.—The Secretary of State has issued a license for the incorporation of the Herris & Johnson City Railway Company, with principal office in East St. Louis. The capital stock is nominally $10,000. The incorporators and first board of directors are : L. O. Whitnell, C. M. Forman, H. L. Browning, Wm. S. Forman and L. S. McWilliams, all of East St. Louis.

GREENFIELD, IND.—The Commissioners of Hancock County have granted a franchise to the Indianapolis, New Castle & Toledo Electric Railway Company for a branch line from Greenfield to Maxwell.

MARYSVILLE, CAL.—The Northern Electric Company, H. A. Butters, president, has closed a contract with the Westinghouse Electric & Manufacturing Company for three 400-k.w. motor-generator sets for the three substations on its new road now in course of construction between Chico and Oroville.

VINCENNES, IND.—The Vincennes, West Baden & Louisville Traction Company has closed contracts for the construction of its line. A large Philadelphia construction company, representing Eastern capital, has taken the contract at $2,000,000. The contract for the power house was let to another Pennsylvania concern for $300,000. The power house will be built either at Petersburg or Otwell. The line will run from Vincennes to French Lick, a distance of 66 miles.

INDIANAPOLIS, IND.—Articles of incorporation have been filed with the Secretary of State by the Indianapolis, Crawfordsville & Western Traction Company. The capital stock is $2,000,000. The new company has purchased all the assets of the Consolidated Traction Company, including franchises in Indianapolis, Crawfordsville, Covington and intervening towns, and county rights-of-way. The company proposes to complete the grade and road began by the Consolidated Company between Indianapolis and Crawfordsville and then build westward to Covington and Danville. The incorporators are: A. F. Ramsey, A. E. Reynolds, C. N. Van Cleve, E. P. Baker, G. P. Haywood, W. C. Mitchell, Edward Hawkins and A. A. Barnes.

PORT HURON, MICH.—The Rapid Railway Company will enlarge its power house and freight house in this city.

ST. LOUIS, MO.—The St. Louis Track Company has been incorporated with a capital stock of $5000, fully paid. The object of the corporation is to prepare and build the roadbed and lay tracks for railroads, etc. The incorporators are: J. H. McInery, Charles S. Belden and D. Walker Wear.

NEW YORK, N. Y.—The New York Railroad Commission, which has been investigating the recent accident on the New York Elevated Railway, has made its report. Paul Kelly, the missing motorman of the train, and Towerman Jackson are both held responsible for the accident. Kelly is blamed for running by the Sixth Avenue signal set against him, and Jackson because he set the Sixth Avenue switch against a Ninth Avenue train. The Commission makes various recommendations for changes in the matter of signals and operation of trains with a view to avoiding such accidents in the future.

ALLENTOWN, PA.—The Lehigh Valley Transit Company has closed contracts with the General Electric Company for a new plant which will have turbo-generators and many improvements costing several hundreds of thousands of dollars.

SHARON, PA.—The merger of the Pennsylvania & Mahoning Valley, Sharon & New Castle, and Youngstown & Sharon Traction companies is now assured. The deal involves the consolidation of almost $5,000,000 in railway properties and valuable franchises. The properties will be merged under the name of the Mahoning & Shenango Railway, Light & Heat Company. Extensive improvements will be made by the new concern, and $3,000,000 is to be set aside for betterments. Among the improvements will be the building of a line from New Castle to West Pittsburg, and another is contemplated between New Castle and New Wilmington, which may be extended to Mercer.

CHARLESTON, S. C.—On account of inability to get rights of way, it is reported that the new Charleston and Summerville Electric Railway may have to abandon its plans, at least temporarily. Part of the construction outfit is reported to have been sold by the owners and promoters.

UNION CITY, TENN.—The Union City & Reelfoot Railway Company, of Obion County, has been incorporated with a capital stock of $100,000. The incorporators are R. P. Whitesell, J. C. Burdock, T. B. Greer, A. E. Darrah, W. M. Turner, C. P. Wilson, John White, F. M. McGree, John Thaw, H. C. Sanfield and J. C. Reynolds.

WINNIPEG, MAN.—It is stated to be the intention of the Canadian Pacific Railroad to double track the road to Fort William, and to use electricity upon the mileage involved for a special service. The energy will be secured from the water powers near the line of the railway.

VERA CRUZ, MEX.—The State of Vera Cruz has granted to Alfredo Kennion a concession for the construction of a suburban railway system connecting the several towns in the neighborhood of Orizaba with the latter, the question of generating electrical power from the neighboring waterfall, which is of immense volume, being under consideration.

TORONTO, ONT.—It is announced that negotiations are being conducted for the sale of the franchise of the St. Catherines, Pelham & Welland Electric Railway to the Toronto & Niagara Power Transmission Company. This will give the Toronto and Niagara a route out of St. Catherines and into Welland, and a spur from Fonthill to Fenwick will be constructed also.

New Industrial Companies.

THE SCOTT ARC LAMP COMPANY, of Jersey City, has been incorporated with a capital of $1,000,000. Incorporators: Louis B. Dailey, Thomas F. Barrett and L. H. Gunther.

THE ROONEY ELECTRIC COMPANY, of New York, has been incorporated. Capital, $50,000. Directors: J. J. Rooney, Scarsdale; F. J. Rooney, John Rooney, Brooklyn.

THE ELEVATOR OPERATING CONTROLLER COMPANY, New York, has been incorporated with a capital of $10,000. Directors: Sam Loewy, C. F. Lewis and L. J. Doolittle, New York.

THE BIRMINGHAM ELECTRIC COMPANY, of Birmingham, Ala., has been formed, with a capital stock of $5,000. The incorporators are: C. J. Martin, Jr., D. A. Hunt, Alice Arvetta Hunt.

THE L. L. L. ELEVATOR CONTROLLER COMPANY, New York, has been incorporated with a capital of $25,000. The directors are: Sam Loewy, C. F. Lewis and L. J. Doolittle, New York.

THE AJAX ELECTRIC MANUFACTURING COMPANY, of Boston, has been incorporated with a capital of $5,000. The incorporators are: Charles C. Walker, Fred E. Smith and Leslie K. Storrs.

THE AMERICAN VOLTA COMPANY, New York, has been incorporated with a capital of $100,000. Directors, J. A. White, Meriden, Conn.; P. P. Lynn, New York, and William Hotchkiss, Montclair, N. J.

VAN FRANK ELECTRIC MANUFACTURING COMPANY has been incorporated at San Francisco, with a capital stock of $50,000, by J. E. Gordon, Thos. Mirk, H. I., F. T. and E. M. Van Frank.

THE MAINE DYNELECTRIC COMPANY has been organized at Lewiston, Me., for the purpose of conducting a general business in manufacturing and dealing in dynamo-electric and other power, heating and illuminating machinery. Officers: President, Dr. M. B. Smiley, of Auburn; treasurer, E. L. Philoon, of Auburn.

THE AUTOMATIC CLUTCH COMPANY, of Akron, Ohio, has been incorporated with a capital of $50,000. The incorporators are: Will Christy, L. C. Miles, E. E. Andrews, Frank Adams and G. G. Allen. The company will manufacture an automatic clutch invented by Mr. E. E. Andrews, of the Akron Electrical Manufacturing Company.

THE SELECTIVE TELEPHONE MANUFACTURING COMPANY, of Springfield, Ohio, has been incorporated with a capital stock of $60,000. The company will manufacture a selective telephone apparatus. Among those interested are Messrs. James M. Brailey, of Toledo; C. D. Juvenal and William M. Bruce, jr., of Springfield.

THE INTERSTATE TUNNEL RAILWAY COMPANY, New York City, has been incorporated to construct and operate a tunnel two miles long under the Hudson River between New York and New Jersey. The capital is $7,500,000. Directors: John B. McDonald and John D. Crimmins, New York; Mark T. Cox, East Orange, N. J., and Charles Stallings, Newark, N. J.

Personal.

B. V. SWENSON.

PROF. BERNARD V. SWENSON, of the University of Wisconsin, has been elected secretary of the American Street and Interurban Railway Association. He is a native of Chicago, where he was born May 3, 1872. After a preliminary education in the public schools of Chicago and at the Chicago Manual Training School he was graduated from the latter institution in 1889. Prof Swenson then entered the engineering school of the University of Illinois, from which he was graduated in 1893, completing both the courses in mechanical and electrical engineering and receiving the degree of bachelor of science in each course. He then engaged in instructional work in the university from 1893 to 1898, the last three years as assistant professor of electrical engineering. During this time he spent the summer of 1894 in travel in Europe and the summer of 1895 in graduate study at Cornell. Prof. Swenson was appointed assistant professor of electrical engineering at the University of Wisconsin in 1898, and has been connected with this institution up to the present time, although he has been on leave of absence for the past year on account of his work as assistant superintendent with the Electric Railway Test Commission. He received the master's degree in mechanical engineering from the University of Illinois in 1901, and the master's degree in electrical engineering from the University of Wisconsin in the same year. Besides his important work with the Electric Railway Test Commission, in which he has been associated with Prof. Norris, of Cornell University, and Prof. Goldsborough, of Purdue University, Prof. Swenson was a member of the International Jury of Awards at the Louisiana Purchase Exposition, and secretary of one of the electrical sections of this jury. He is joint author of "Testing Electro-Magnetic Machinery," Vol. I, by Bernard V. Swenson and Budd Frankenfield; the Macmillan Company, 1904; 420 pages octavo. The second volume of this book is now in preparation. He is also joint editor (with Prof. H. H. Norris, of Cornell University) of the "Report of the Electric

Railway Test Commission," now in press. He has also been a frequent contributor of papers and articles for the technical and semi-technical press. Prof. Swenson has also acted as consulting engineer in the design and on the superintendence of construction and testing of electric light and power plants and of electric railways, during the past ten years, when not occupied with other duties. Prof. Swenson is a full member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, and is an associate member of the National Electric Light Association. He has also served as chairman of the local branch of the American Institute of Electrical Engineers, at Madison, Wis., for two years, and is a member of Tau Beta Pi, an honorary engineering fraternity, and also of the Phi Delta Theta Fraternity.

CHARLES GARLAND.

MR. CHARLES GARLAND has recently resigned the position of secretary of The Westinghouse Machine Company to join the Pittsburg Fireproofing Company as vice-president and treasurer. Mr. Garland enjoys the distinction of having remained in the continuous service of one establishment for over 21 years. Arriving in Pittsburg from Ireland in 1883, at the age of 14, he entered the employ of The Westinghouse Machine Company, which at that time had been in existence but three years. From a minor position Mr. Garland gradually advanced, until in 1896 he was appointed assistant secretary and assistant treasurer. Two years ago he was advanced to the full secretaryship, which he held up to the time of his resignation. The Pittsburg Fireproofing Company, with which Mr. Garland has become identified, is engaged in the manufacture of fireproof materials of many kinds, with works located at West Pittsburg, Lawrence County, Pa., and main offices in the Bailey-Farrell Building, Pittsburg, where Mr. Garland has his headquarters. Mr. Garland will continue his residence at Edgewood Park, Pa., where he is a prominent member of the Edgewood Club, of which he has for some time past been secretary.

HARRY H. ADAMS.

MR. HARRY H. ADAMS, M. E., who has just been elected president of the American Railway Mechanical and Electrical Association, was born in Jersey City, N. J., Jan. 7, 1871. His early education was obtained in the Jersey City public schools and later he attended Trinity Church School in New York. He entered Stevens Institute and graduated in the class of 1893. After graduating he entered the service of the Consolidated Traction Company of New Jersey, which was later merged into the North Jersey Street Railway Company, holding successively the positions of foreman of motor repair shops, assistant electrical engineer and finally master mechanic. This last position he held until Jan. 1, 1902, when he entered the services of the United Railways & Electric Company of Baltimore, Md., as superintendent of shops, in charge of the rolling stock and buildings, holding this position up to the present time. Prior to his election as president of the Association, he served as first vice-president.

PROF. ELIHU THOMSON has just returned from his European trip, arriving on the "Teutonic," much benefitted by the change and rest.

MR. ROBERT BRUCE STEWARD, of the D. M. Steward Mfg. Co., of Chattanooga, Tenn., and president of the D. M. Steward Mfg. Co., of Canada, was in New York during the past week.

MR. JOHN I. SABIN, of the Pacific States Telephone Company, is to take a well-earned rest and, it is said, spend some six months on a Europe trip of travel and recreation.

MESSRS. C. K. SIEBERT, S. A. Duval and W. H. Roberts, of Elkhart, Ind., have formed a company for the manufacture of telephone supplies, with headquarters and factory in Chicago.

MR. J. E. KINGSBURY, representing the Western Electric Company in London for many years past, has been visiting this country and Canada with his family, and returned to England this week.

MR. R. G. HUNT, of the Fort Smith Gas and Electric interests, has become manager of the Consolidated Gas & Electric Company, of San Diego, Cal., which is conducted under Byllesby auspices.

MR. E. T. SCHATTLE, formerly connected with the Crouse-Hinds Company, of Syracuse, has accepted a position with the Crescent Electrical Manufacturing Company, of Rochester, where he will have full charge of the engineering department.

MR. BION J. ARNOLD, of Chicago, was a visitor in New York recently to meet his daughter on arrival from Europe and to place her as a "freshman" at Wellesley College. Outside his electric railway construction, etc., Mr. Arnold has of late had a good deal of steam railway work.

MR. O. A. STRANAHAN, who joined the Allis-Chalmers Company on December 1, 1904, to become manager of the power department, has been promoted to the position of sales manager. He assumed the duties of his new place on September 1. His headquarters are at Milwaukee.

MR. E. H. McHENRY, fourth vice-president of the New York, New Haven & Hartford Railroad, who has at present the supervision of the engineering department of the electrical division, will, after Oct. 1, have direct supervision of the engineering department of the entire New Haven system.

MR. F. B. HUNTINGTON, the secretary of the Eastern Wisconsin Railway & Light Company, has been elected to the office of vice-president, to fill the vacancy caused by the resignation of Mr. T. F. Grover as vice-president and general manager. Mr. Huntington will retain the secretaryship for the present.

MR. ROBERT McF. DOBLE, consulting engineer of the Abner Doble Company, San Francisco, has returned from a trip of several months through the Sierre Madre Mountains on the west coast of Mexico and also in Colorado, where he was engaged in making examinations of several important electric long-distance power projects.

MR. JOHN GAVEY, C. B., engineer in chief and chief electrician of the British telegraphs, has been spending several weeks in this country, going as far as the Pacific Coast and visiting the Grand Canon of the Colorado. He sailed for home on the "Oceanic" this week, much benefitted by the trip. While here he made a special study of telephonic development.

MR. M. C. MILLER, who joined the Allis-Chalmers Company, a little more than a year ago, has been made assistant to the sales manager, with charge of all matters in that department which do not require the personal attention of the sales manager. Mr. Miller was formerly connected with the Westinghouse Electric & Manufacturing Company at Pittsburg.

MR. H. U. BADEAU has been appointed New York representative of the Switchboard Equipment Company, of Pittsburg, with headquarters at 39 Cortlandt Street. Mr. Badeau is a graduate of Rutgers College in the department of electrical engineering, and for the past several years has been with the engineering department of the Western Electric Company in New York.

MR. ERRETT L. CALLAHAN, the manager of the Promotheus Electric Company, of New York, has resigned to take charge of the electric heating work of the General Electric Company in the Chicago territory. Mr. Callahan has been very active in the electric heating field for the past four years, having also been connected with the Simplex Electric Heating Company as assistant manager.

MR. PHILIP TORCHIO, chief electrical engineer of the New York Edison Company, who has been spending several months in Italy with Mrs. Torchio, has returned home from his native land. A large part of the holiday was spent by Mr. and Mrs. Torchio on the beautiful shores of Lake Como. One incident of the trip was a luncheon given in Milan by a number of the Italian electrical guests in America last year.

MR. A. T. TOMLINSON has been transferred from the New York office of J. G. White & Co. to the Montreal offices of the Canadian White Company. He is a graduate of the Royal Military College of Canada. For six years he was engaged on railway work, a great part of his time being spent in Nebraska and Colorado. He also had charge of work on the Burlington & Missouri Railway, and the Denver & Rio Grande Railway. Mr. Tomlinson was with the Brooklyn Elevated Railway for about three years, and during that time had charge of the construction of about 1½ miles of road. In 1894 he went to Chicago to take charge of the extension of the Lake Street Elevated Railway. He afterwards became principal assistant and then assistant chief engineer of the Union Loop & Northwestern Elevated Railway, Chicago. In 1898 he was called to Boston to assist in the building of the Boston Elevated as consulting engineer. He had charge of a large part of the construction, and resigned before the completion of the work, entering the employ of the White Company in 1902.

MR. W. T. McCASKEY, who was, until recently, manager for Agar-Cross & Co., of London, and for years before identified with Edison, Westinghouse and other electrical interests, has joined the Allis-Chalmers Company and will act as a special representative where contracts are being considered for such work as the equipping of interurban railroads, hydro-electric projects and others requiring special knowledge. Mr. McCaskey is a native of Wisconsin, having been born in Richmond County, in 1863. His experience in electrical work began in 1882, when he took charge of the plant of the Eau Claire Electric Light & Power Company. Later he was connected with Sperry Associate Electric Company, of Kansas City, and he operated the first electric lighting plant in Fort Worth, Tex., in 1885. From 1889 to 1894 he was on the Pacific Coast for Edison and other interests. He spent the years from 1894 to 1899 in Chicago as a representative of the Standard Electric Co., etc., and then went to Buenos Ayres, South America, to represent the Westinghouse Electric & Manufacturing Company, and Agar, Cross & Co., remaining until 1901. He was director in Spain and Portugal for the Societe Anonyme Westinghouse until December, 1903, and manager for Agar-Cross & Co., until May 1 of this year. Mr. McCaskey will make his headquarters in Milwaukee.

Legal.

EMINENT DOMAIN FOR TRANSMISSION LINES.—In an opinion the Supreme Court of Washington State holds that the right of eminent domain does not extend to a company organized to generate and transmit electricity, unless public necessity requires it and the rights of the public to the use and enjoyment of the property have been regulated, guaranteed and safeguarded by legislation. The decision is said to dispose of the efforts of the White River Power Co. to acquire property of a rival corporation for a right of way for a canal. The White River Company proposes to dam the White River near Buckley, transport the water by canal to Lake Tapps, convert the lake into a reservoir and convey the water to Sumner, where 50,000 electric

horse-power would be generated and all towns and cities on Puget Sound as far south as Olympia and north to the boundary line be supplied with light and power.

OCCUPANCY OF HIGHWAY.—In the appeal of the Ohio Postal Telegraph-Cable Company versus the Board of Commissioners of Sandusky County, the request of the company for an injunction to prevent the threatened removal or destruction of its lines by the local officers is granted and sustained by the Circuit Court for the Northern District of Ohio. It is held that a telegraph company which has built its line on a public highway, which is a post road with the consent of the local authorities having jurisdiction, and has filed its acceptance of the provisions of Rev. St. § 5263 (U. S. Comp. St. 1901, p. 3579) cannot be required to remove such line without compensation, nor can it be removed by the authorities, because since its erection it has become an inconvenience to the public, by reason of the construction of a street railway which occupies a portion of the highway, also, by consent of the authorities.

Obituary.

MR. F. B. HOSKINS.—We regret to note the sudden death by appendicitis of Mr. Frank B. Hoskins, ex-mayor of Fond du Lac, Wis., and president of the Eastern Wisconsin Railway & Light Company. He was born in Chenango County, N. Y., August 20, 1850, in which year his parents moved to Wisconsin. He began his business career in the First National Bank of Fond du Lac, and was later engaged prominently in wagon and hardware enterprises. He was elected register of deed on the Democratic ticket in 1878, served as a member of the common council and board of education, and was mayor in 1898 and 1899. For many years he was chairman also of the library board. Probably no other citizen had more business interests in the city than Mr. Hoskins. He was president of the Eastern Wisconsin Railway & Light Company, an office he had held for two years; he was president of the Harrison Postal Bag Rack Company and had been connected with that concern for about twenty years as secretary and president; he was secretary of the Fond du Lac Canning Co.; vice-president of the Fond du Lac Improvement Co., secretary and treasurer of the Citizens' Building Co., a director in the Commercial National Bank, a stockholder in the Fond du Lac Land Company and the Nehrbrass Casket Company. He was also a leading member of the Knights of Pythias. He leaves a widow and two sons.

MR. W. B. RANKINE.—We note with profound regret the death on September 30 of Mr. William B. Rankine, vice-president of the Niagara Falls Power Company, at Franconia, N. H., to which place he went for the benefit of his health August 12. The cause of death was congestion of the lungs, superinduced by heart trouble. Mr. Rankine was born at Owego, January 4, 1858. He was interested in the organization of the Niagara Falls Power Company, and at the time of his death was vice-president of that company, and of the Canadian Niagara Power Company and was in a large number of allied concerns. Besides his wife and mother, he is survived by three brothers, Harold, Delancey and Richard. Mr. Rankine's father was the Rev. Dr. James Rankine, an Episcopalian minister, at one time president of Hobart College. He entered Hobart in 1873 and left to go to Union College two years later. While at college he became one of the corporators of the Alpha Delta Phi fraternity. He was graduated in 1877. For the next four years he lived in Niagara Falls. He then came to New York City and entered the law firm of Vanderpoel, Green & Cummings. Three years later he struck out for himself. It was while living at Niagara Falls that he first conceived the idea of utilizing the great natural forces in the Niagara River and Falls for the production of power for commercial purposes. While in New York City he met prominent financiers and interested them in his plans. His leading associate and confidant was Mr. Edward D. Adams, to whom and himself, more than any other men, the modern utilization of Niagara on a grand scale is due. He succeeded in forming a company, called the Niagara Power Company, and became its secretary and treasurer. Later he was made a vice-president. Mr. Rankine always acted as the chief executive of the company, and spent his time between the works and the main office in New York City. Eventually he went again to live in Niagara Falls. For many years he was a member of the committee on admissions of the University Club. He also belonged to the Metropolitan Club and the Bar Association. Besides the Niagara Power Company, the Natural Food Company, one of the largest concerns in the city, paid him a salary as a member of its executive committee. In February, 1904, he married Miss Annette Norton, of Detroit, Mich. She was a few years younger than her husband. The funeral was held at the Episcopal Church, in Niagara Falls, at 11 o'clock last Tuesday morning. Mr. Rankine had a fine personality and made many strong and warm friendships. His hospitality at Niagara Falls will be remembered by many readers of this tribute to his worth and memory.

Trade Publications.

STEAM HAMMERS.—Bulletin 805 of the David Bell Engineering Works, Buffalo, N. Y., is devoted to single-frame steam hammers with reinforced guides and stiffened columns.

STEAM TRAPS.—The Youngstown Steam Trap Company, Youngstown, Ohio, has issued a neat illustrated catalogue devoted to steam traps. The construction of the device is well shown by means of cross-sectional views.

STOCKS AND DIES.—The Armstrong Manufacturing Company, Bridgeport, Conn., has issued a 48-page catalogue describing water, gas and steam fitters' tools and machines for cutting off and threading pipe.

LATHES.—Catalogue J4 of the Gisholt Machine Company, Madison, Wis., is an exceptionally neat publication presenting the constructional features and operating characteristics of Gisholt lathes, boring mills and tool grinders.

TRANSFORMERS.—The Wesco Supply Company, St. Louis, Mo., has issued an interesting catalogue dealing with Moloney transformers. The elements which have been considered in the design of these transformers are treated quite fully.

LINE CUT-OUTS.—Bulletin No. 26 of the H. T. Paiste Company, Philadelphia, is an advance circular of catalogue No. 12, which is now on the press. The bulletin describes wooden and iron panel boxes, panel cut-outs, cartridge cut-outs and entrance switches.

LAMP SOCKETS.—A trade postal of Pass & Seymour, Solvay, N. Y., is intended to draw attention to the P. & S. double-pole sockets. These sockets leave no chance for grounding; they have copper contact shells instead of the more usual brass or copper-plated ones.

TROLLEY LINE FIXTURES.—The Fletcher Manufacturing Company, Dayton, O., has just issued Price-List No. 531, dealing with sleet-proof pulleys, windlasses, mast arms, incandescent brackets, wire holders, insulated clamps, insulated racks, iron brackets, break arms and pins.

STEAM TURBINES.—The DeLaval Steam Turbine Company, Trenton, N. J., has issued a vest pocket catalogue dealing with steam turbine machinery. Illustrations are given of turbine-driven, direct-current and alternating-current generators, turbine-driven pumps and blowers.

TWO-STATION TELEPHONES.—The Electric Gas Lighting Company, 115 Purchase Street, Boston, has issued an illustrated folder, which serves to present the characteristics of the "Stayrite" two-station telephones. These telephones are designed for private lines and permit of the use of only two stations.

IRON AND STEEL WORKS EQUIPMENT.—The Wellman-Seaver-Morgan Company, Cleveland, O., has issued a well-illustrated catalogue dealing with charging and manipulating apparatus for open-hearth and re-heating furnaces. These machines are operated similarly to cranes, and are for the most part electrically driven.

LIGHTING SWITCHES.—A. P. Lundberg, 477 Liverpool Road, London, N., has issued some interesting literature dealing with switches of the quick-break type for lighting circuits. These switches are of the double-throw type, and are intended for use in connection with the control of a lighting circuit from any one of a number of different points.

INCANDESCENT LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, has issued a folder with the title, "Lamp Limericks," which serves in a practical way to direct attention to the fact that in order for the user to obtain satisfaction from electric lamps he should act upon the well-known suggestion and "Better Buy Buckeye."

FORGE BLOWERS.—Leaflet No. 145 recently issued by the Northern Electrical Manufacturing Company, Madison, Wis., is devoted to forge-blower equipments. The blowers, which are direct connected to the driving motors, are built for outputs ranging from 75 to 425 cubic feet of air per minute under a pressure of 1.5 ounces.

TELPHERAGE.—Book No. 35 of the United Telpherage Department of the Dodge Coal Storage Company, Philadelphia, is a well-illustrated catalogue describing numerous telpherage plants now in successful operation. As a method of transporting materials, boxed, barreled or loose, solids or liquids, telpherage has proved entirely satisfactory.

NERNST LAMPS.—The Nernst Lamp Company, Pitttsburg, Pa., has issued a circular descriptive of the Nernst 220-440 volt, three-wire, alternating-current system, for small cities. A recent issue of the "Nernst Central Station Bulletin" reprints three letters which serve to show the beneficial effects which have followed the adoption of Nernst lamps by electric lighting companies.

METAL SHAVING MACHINE.—Bulletin No. 203 of the Jenney Electric Manufacturing Company, Indianapolis, Ind., deals with motor drive for curved-plate shaving machine. The motor, which is attached rigidly to the end of the driven machine, is furnished with enclosed heads to protect the windings and current-carrying parts and with doors to permit ready access to the brushes. The motor is of the compound-wound type.

ENCLOSED ARC LAMPS.—The American Arc Lamp Company, Kalamazoo, Mich., has recently issued its first catalogue of enclosed arc lamps. The lamps described have been in use for several years, having been originally placed upon the market by the Lea Electric Manufacturing Company, Elwood, Ind., but they have lately been improved in many important respects. These lamps are of both the direct-current and alternating-current types.

MILLING MACHINES.—The Cincinnati Milling Machine Company, Cincinnati O., has recently issued a 109-page catalogue illustrating a complete line of milling machines and attachments. The essential features of each machine are fully discussed. Among the new attachments are one for high-number indexing, one for rack indexing, an attachment for milling large cams and an attachment for milling worm wheels. The arrangement for direct-connected motor-driven millers is described at length.

RAILWAY APPARATUS.—The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has issued special publication No. 7040, devoted to Westinghouse railway apparatus. Illustrations and descriptions are given of direct-current railway motors, single-phase alternating-current motors, alternating-current generators, unit-switch system of train control and electric locomotives. One of the most interesting illustrations is one showing an external view of a 135-ton, 6600-volt, single-phase electric locomotive which is equipped with the sliding-bow type of pantagraph trolley.

RAILWAY SIGNALS.—The Blake Signal & Manufacturing Company, 246 Summer Street, Boston, has issued an illustrated catalogue dealing with the Blake signal system for electric and steam railroads. The Blake signals are practically visual telephone signals, and their use removes the one-sided feature of railway line telephone systems. It is not an automatic signal in the usual acceptation of the term, but it is intended for use in connection with a telephone system. The purpose of the signal is to allow the dispatcher selectively to signal to any telephone point on the line when he wishes to communicate with the passing crews.

TROLLEY LINE MATERIAL.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a well-illustrated catalogue of 350 pages dealing with trolley line material. This catalogue is designated as No. 14 and is divided into 14 sections, as follows: Section I, trolley wire hangers, mine hangers, pull-overs; Section II, trolley cars, clips, splicing sleeves; Section III, strain insulators, turn buckles; Section IV, pole bracket arms, section insulators; Section V, pole line and third rail insulators; Section VI, miscellaneous material; Section VII, tools; Section VIII, "Noark" enclosed fuses and devices; Section IX, molded mica-sockets; Section X, electric heaters and electrotherms; Section XI, vulcabeston and molded materials; Section XII, general information and data; Section XIII, telegraph code; Section XIV, indexes.

SYNCHRONISM INDICATOR.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4418, which serves to present the operating features of its synchronism indicator. The pointer of this instrument moves around the hands of a dial, and the angle of the pointer's displacement from the vertical position is a measure of the angle of phase difference between the two sources of electro-motive force to which the device is attached. If, therefore, the incoming machine is running too fast, the pointer rotates in one direction, and if too slow, in the opposite direction. Coincidence in phase is shown when the pointer remains stationary in a vertical position, and indicates that the machine should be thrown in. The constructive details of the indicator are outlined, and diagrams are given to show in what way it should be connected in the circuits of the generators.

News of the Trade.

THE CHICAGO BATTERY COMPANY has been incorporated in Jersey City; capital, $125,000. Incorporators—Francis H. Howland, Charles L. Young, Benjamin J. Downed.

THE HAZELTON & DONALD MACHINE COMPANY, manufacturers of the well-known Acme metal saw table, has sold its business to the Hub Machine & Tool Company, 116 S. Sixth Street, Philadelphia, which will continue to carry on the manufacture of this machine as well as the other specialties put on the market by Hazelton & Donald.

THE SWITCHBOARD EQUIPMENT COMPANY, of Bethlehem, Pa., has opened a New York office at 39 Cortlandt St., which will be under the charge in Mr. H. U. Badeau. Mr. Badeau is a graduate of Rutgers College, Department of Electrical Engineering, and for the past few years has been with the engineering department of the Western Electric Company in New York.

THE R. M. CORNWELL COMPANY, of Syracuse, N. Y., is meeting with great success in marketing its new gasoline electric lighting outfit. This outfit includes its new "Wonder" gasoline engine and the "Wonder" generator. Many large orders have been taken recently, considerable of the business coming from abroad; one order for four outfits and twelve style "A" generators being received from Lima, Peru.

THE AMERICAN CAR & FOUNDRY COMPANY has recently added to its equipment at the Madison plant, Granite City, for the construction of steel and composite cars, among the equipment being 100 Boyer long stroke riveting hammers manufactured by the Chicago Pneumatic Tool Company. The Chicago Pneumatic Tool Company reports that business in general continues good and the prospects for the remainder of the year very bright.

THE CRESCENT ELECTRICAL MANUFACTURING COMPANY, of Rochester, N. Y., has recently reorganized. Mr. Windle W. Smith, who was formerly secretary, becomes president and general manager; the new treasurer is Mr. Benjamin S. Meyer. The reorganization provides for greatly increased manufacturing facilities. To this end, larger accommodations are being provided, and new machinery of the latest and most improved type is being installed. A new specialty that this company is putting on the market, and which is already meeting with great success, is a line of panelboards of all capacities and types. In order to handle special work in this line, a well-equipped engineering department is provided. The complete line of switches, fuses, plugs, cutouts, sockets, receptacles, attachment plugs, terminal lugs, etc., which the company has been putting on the market for some time, will, of course, be continued.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting Ithaca, N. Y., May, 1906.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Civil Engineers. Secretary, Chas. W. Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street Railway Association. Secretary, B. V. Swenson, New York.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, 56 Pine St., New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa.

Electrical Trades Association of Canada. Secretary, J. A. Mann, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, D. Davis, Litchfield, Ill. Ill. Next meeting, Peoria, Oct. 5 and 6, 1905.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., Oct. 14 and 15, 1905.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association.. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

Missouri Independent Telephone Association. Secretary, Frank S. Leach, Sedalia, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Cleveland, O., July 18, 1906.

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 1142 Wells Building, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in January, 1906.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio. Next meeting, Canton, O., Nov. 17 and 18, 1905.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, C. B. Fairchild, Jr., 114 Liberty St., New York.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 26, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,154. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Feb. 7, 1905. A multiplex telegraph system in which a simple Morse circuit has superposed upon it rapid alterations or impulses of opposite polarity. In order to economize such alternating current, the idle shunt circuit hitherto indispensable in this sort of apparatus is always automatically cut out at the transmitting station, so that the full effect of the current is utilized.

800,155. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Mar. 11, 1905. Relates to modifications of the above.

800,156. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Mar. 31, 1905. Cuts the main generator in and out of the main circuit in the act of transmitting signals, while maintaining the line intact by the use of a continuity-preserving transmitter.

800,157. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Apr. 3, 1905. Details of circuits relating to a multiplex telegraph.

800,158. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Apr. 27, 1905. Means for repeating from a Morse circuit into the alternating current side, and vice-versa.

800,160. MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES; Milo G. Kellogg, Chicago Ill. App. filed Nov. 30, 1891.

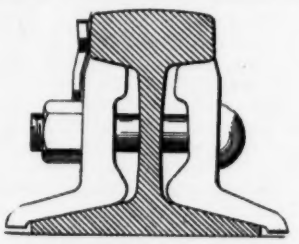
800,161. SWITCHBOARD FOR MULTIPLE EXCHANGES; Milo G. Kellogg, Chicago, Ill. App. filed Aug. 24, 1893.

800,170. MEANS FOR SECURING ELECTRIC CONDUCTORS; Carroll Potter, Philadelphia, Pa. App. filed Sept. 16, 1902. A form of staple for securing electric conductors to a panel board. The marble face of the board is drilled with holes inclined to one another so that when the staple is driven therein it cannot be readily withdrawn.

800,179. ELECTRIC SIGNALING SYSTEM; Howell W. Souder, Tamaqua, Pa. App. filed Jan. 27, 1905. An apparatus for controlling the signaling circuits of a trolley road block system including a pair of magnets, each of which is arranged to close the circuit of the other magnet, whereby they cannot be simultaneously operable. Lamps are displayed along the block whenever a car enters the same from either end.

800,181. METHOD OF PRODUCING ELECTRODES; Heinrich Specketer, Griesheim-on-the-Main, Germany. App. filed Feb. 18, 1903.

800,204. CIRCUIT BREAKER; Charles H. Brigham, New York, N. Y. App.



800,229.—Rail Bond.

filed Mar. 19, 1904. A thermostat in which the heat coil is wound in a casing having zinc and steel projecting rods. The relative movement of the rods under the influence of the heat releases a catch and effects the short circuit of the "sneak current."

800,229. RAIL BOND; George A. Mead, Mansfield, O. App. filed Dec. 1, 1904. A form of rail bond designed to be soldered to the side edges of the respective rails. Minute projections are arranged upon the face of the bond to be soldered in order to hold the bond away from the rails and provide sufficient room for the solder to flow.

800,253. RAIL JOINT; George W. Whitman, Pleasanton, Kan. App. filed Feb. 24, 1904. The usual fish plate is provided with cut-away portions upon its upper edge for the rail bond.

800,294. TROLLEY POLE AND STAND; William W. Hallenbeck, Burrville, Conn. App. filed Jan. 12, 1905. A form of stand for trolley poles having two sets of ball bearings with horizontal and vertical raceways, respectively.

800,296. ANTI-CORROSION DEVICE FOR SURFACE CONDENSERS; Anthony Harris, Greenock, Scotland, and Frederic A. Anderson, Westminster, England. App. filed Apr. 25, 1905. The protective metal is supported by an insulated plate within a separate receptacle having communicating pipes to the condenser to allow water circulation. The condenser wall is in electrical connection with the protective metal.

800,315. CIRCUIT INTERRUPTER; George P. McDonnell, St. Louis, Mo. App. filed Aug. 5, 1903. A disk having spaced contact blades is rotated by an electric motor and serves to periodically charge line wires, across which may be connected any number of bells, which can be rung by separate push buttons.

800,370. MAGNETIC SEPARATOR; Charles M. Green, Lynn, Mass. App. filed Oct. 17, 1901. A drum-shaped magnet comprising two similar interlocking core bodies having pole pieces formed thereon is rotated in proximity to a hopper for feeding the ore. A revolving brush is effective to remove the magnetic material from the pole pieces.

800,375. LOAD METER; Elton J. King, Fort Wayne, Ind. App. filed Sept. 6, 1902. In order to adjust an alternating-current meter for vibration purposes without varying its phase relation, a small electromagnet is included in a shunt circuit from the mains, having a variable resistance therein, which serves to assist the usual damping devices.

800,376. TRAIN-LIGHTING SYSTEM; Sigvald Krohn, Berlin, Germany. App. filed Jan. 21, 1905. (See Current News and Notes.)

800,380. PROCESS OF PRODUCING ALKALI AND ALKALINE-EARTH-METAL HYDRIDS; Florentine J. Machalske, Brooklyn, N. Y. App. filed July 12, 1905.

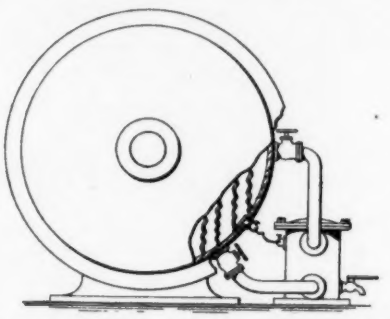
800,382. DYNAMO ELECTRIC MACHINE; John P. Mallett, Madison, Wis. App. filed May 10, 1901. The field magnet cores are made of wrought iron with flaring ends, upon which may be clamped split pole pieces of a less permeable material. The coils are slipped on the cores and afterward held in place by the pole pieces.

800,394. ELECTROMAGNETIC POWER GENERATOR; Joseph L. Potter and Reinhold A. Miller, Indianapolis, Ind. App. filed Dec. 31, 1904. A toy motor having an electromagnet and an armature connected to a pitman and crank. In order to extend the radius of movement the armature is made in layers, which are attracted successively.

800,404. SAFETY FUSE TERMINAL; Joseph Sachs, Hartford, Conn. App. filed Dec. 14, 1903. Employs a pair of split rings for clamping the line conductors, each of which rings has a flat upper face, upon which is bolted the fuse terminal.

800,472. ALARM SYSTEM; Felix McGloin, New York, N. Y. App. filed Dec. 31, 1902. The different fire alarm boxes are arranged in series upon a single wire, and in order to prevent interference of signals simultaneously given at different boxes, only the box nearest the central station continues its signal under these circumstances. The more remote boxes are delayed until such signal is transmitted.

800,482. SPRING ADJUSTING MECHANISM FOR ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 18,



800,296.—Anti-Corrosion Device for Surface Condensers.

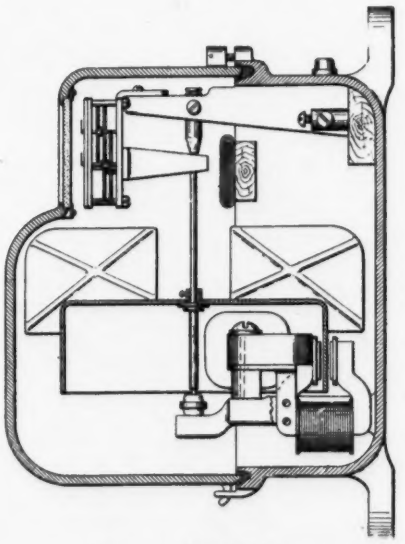
1904. The turn button of a rotary switch has a four-toothed ratchet wheel thereon, the inclined faces of which serve as cams to release a detent after a certain movement. The power spring then acts to throw the switch quickly.

800,515. INCANDESCENT ELECTRICAL FURNACE; Frank J. Tone, Niagara Falls, N. Y. App. filed Dec. 7, 1904.

800,534. SECRET-SERVICE SYSTEM FOR INTERCONNECTING TELEPHONE LINES; Albert K. Andriano and Herman Herbstritt, San Francisco, Cal. App. filed Jan. 26, 1901.

800,538. APPARATUS FOR USE IN THE DISTRIBUTION OF ALTERNATING ELECTRIC CURRENTS; Arthur Francis Berry, Ealing, England. App. filed Dec. 3, 1904. A supplementary transformer is arranged to be put in series with a main transformer when the load on the distributing system falls below a a predetermined amount and to be short-circuited when the load rises above the predetermined amount.

800,584. TROLLEY WIRE COUPLING; Edward M. Leslie, Cincinnati, O. App. filed Nov. 20, 1903. A tube having tapered ends encloses the abutting sections, and a pair of toothed circular wedges are effective to retain them therein.



800,375.—Load Meter.

800,586. ELECTRICAL ROSETTE; James A. Mebane, South Boston, Va. App. filed Aug. 2, 1904. The rosette is made in two portions, having interlocking V-shaped projections and grooves. The grooves serve an additional purpose of forming a receptable for the fuse wire.

800,603. MAGNETIC CLUTCH MECHANISM; Harry A. Williams, Akron, O. App. filed Feb. 14, 1905. A pair of opposed rings having inclined faces are engaged by intermediate rollers. The clutch is thrown by energizing a magnet, which retards one of the rings so that it acts as a cam and rides upon the roller to become separated from the other ring and engage the friction faces of the clutch.

800,609. ELECTRIC CUT-OUT SWITCH; Nathan W. Crandall, Hartford, Conn. App. filed Nov. 19, 1904. A floor switch having a plate with an opening which is normally closed by an upwardly spring-pressed block. The plug depresses the block into contact with the terminals, and locking means are provided to maintain it so depressed.

800,611. DEVICE FOR CONTROLLING MOTORS; Frederick B. Duncan, Madison, Wis. App. filed Dec. 30, 1901. A system for controlling motor-driven machine tools, involving a single panel board having a rheostat for each motor thereon. The various rheostats are operated magnetically through pawl and ratchet devices. The latter can be set in motion by push buttons at the respective machines.